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Sanitary Institute of Great Britain

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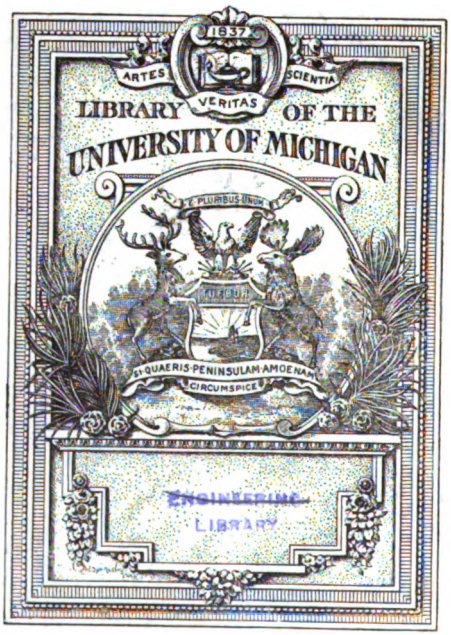
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TRANSACTIONS

OF THE

Sanitary Institute of Great Britain.

VOLUME VI.

CONGRESS AT DUBLIN.

1884-5.

LONDON:
OFFICES OF THE SANITARY INSTITUTE, 74A, MARGARET STREET, W.
EDWARD STANFORD, 55, CHARING CROSS, S.W.

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Sanitary Institute of Great Britain.

Formation of the Institute.

The increasing importance attached to Sanitary Science and the recognised position it was assuming in the public mind, appeared to the promoters of the Sanitary Institute fully to justify the formation of a National Society, the object of which should be to devote itself *exclusively* to the advancement of all subjects bearing upon Public Health. In furtherance of the object, a meeting was held at St. James's Hall, on the 13th of July, 1876, at which His Grace the Duke of Northumberland presided, when it was unanimously resolved:—

First—"That in the opinion of this meeting the sanitary condition of this country is still very unsatisfactory, and that further legislation is necessary with a view to its improvement; and that for the purpose of collecting and imparting information upon all matters connected with the subject of 'Public Health' a Society be now formed, to be styled 'The Sanitary Institute of Great Britain.'"

Second—"That the gentlemen whose names are appended be requested to act as a Committee (with power to add to their number) for the purpose of carrying out the previous resolution and of reporting to an adjourned public meeting to be held during the second week in October next."*

The Committee appointed to report upon the subject considered it would add greatly to the usefulness of the Institute if Mayors of Boroughs, Chairmen of Local Boards, Sanitary Authorities, Medical Officers of Health, and all who have to administer the Public Health Acts, would associate themselves with the Institute, either in their individual or corporate capacity, and take part in its proceedings. By thus bringing their united knowledge and experience to bear upon Sanitary matters, the laws relating to the same would become better known and be more efficiently administered.

Basis of the Constitution of the Institute.

Section I.

Charter of Incorporation, Membership, and Government of the Institute.

As soon as practicable a Charter of Incorporation shall be obtained, as it will facilitate some portions of the work of the Institute, more especially the examinations as set forth in Section II. Until a Charter

* An adjourned public meeting was held on the 14th of March, 1877, when the report was unanimously adopted and a Council subsequently appointed to carry it into effect.

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is obtained, the examinations shall be continued as heretofore, and a Register of persons certificated as competent to act as Local Surveyors and Inspectors of Nuisances shall be formed.

The Institute shall consist of Fellows, Members, Associates, and Subscribers.

Fellows shall be elected by ballot by the Council, and shall include scientific men of eminence, persons of distinction as Legislators or Administrators, and others, who have done noteworthy Sanitary work.

Fellows are only elected from among the Members, and they must have been Members for at least one year before they are eligible for election as Fellows.

All Fellows shall pay a fee of Ten Guineas on taking up the Fellowship, and such fee shall entitle the Fellow to all the privileges and advantages of the Institute for life without further payment.

Any person proposed by three Fellows or Members, shall be eligible for election as a Member of the Institute.

Members shall be elected by ballot by the Council, and shall be eligible to serve on the Council, and to vote at all Elections and Meetings of the Institute. The admission Fee payable by a Member shall be Three Guineas, and the Annual Subscription Two Guineas.

Medical Officers of Health and Medical Men holding Certificates in Sanitary Science from any University or Medical Corporation shall be entitled to be enrolled as Members of the Institute without Admission Fee.

Members desirous of becoming Life Members may do so on payment of Ten Guineas in lieu of the Annual Subscription.

All persons who have passed the Examination and received the Certificate for Local Surveyor from the Institute, shall, by virtue of having so passed, become Members of the Institute upon the payment of Five Guineas (without Annual Subscription), in addition to the fee paid for the Examination.

Any one proposed by two persons, either Fellows, Members, or Associates of the Institute, shall be eligible to be elected as an Associate of the Institute, the election to be by ballot by the Council. The Admission Fee payable by Associates shall be Two Guineas, and the Annual Subscription One Guinea.

All persons who have passed the Examination and received the Certificate for Inspector of Nuisances from the Institute, shall, by virtue of having so passed, become Associates of the Institute upon the payment of Three Guineas (without Annual Subscription), in addition to the fee paid for the Examination.

Persons of either sex, interested in the advancement of Sanitary Science, shall be entitled to be enrolled as subscribers on payment of One Guinea annually.

Donors of Ten Guineas and upwards shall be entitled to be enrolled as "Life Subscribers," with all the privileges and advantages of Annual Subscribers without further payment.

Fellows, Members, Associates, and Subscribers shall be entitled to attend and to take part in the discussions at all meetings and Congresses of the Institute, and shall have free admission to any

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Conversazione given by the Institute and Exhibitions of Sanitary Appliances held in connection with the Institute as long as they continue to pay their Subscription.

Holders of Half-Guinea Congress Tickets are entitled to the use of the Reception Room in the town of meeting, to admission to the Presidental and other Addresses, to all the Meetings, to the Exhibition of the Institute, and to any Conversazione given by the Institute.

The Institute shall be governed by a President, Vice-Presidents, and a Council of Twenty-four, consisting of Fellows and Members of the Institute, of whom not less than two-thirds shall be Fellows. The Council shall be chosen by the Fellows and Members. One-fourth of the Council shall retire annually, and shall not be eligible for re-election for one year.

The first President of the Institute shall be His Grace the Duke of Northumberland. Future Presidents and Vice-Presidents shall be elected by the Council. The Council shall have the power of electing Honorary Members of the Institute, Honorary Foreign Associates, and Corresponding Members of the Council.

Section II.

Objects of the Institute.

To devote itself to the advancement of Sanitary Science and the diffusion of knowledge relating thereto.

To examine and to grant Certificates of Competence to Local Surveyors and Inspectors of Nuisances, and to persons desirous of becoming such or of obtaining the Certificate. The Examinations shall be held at such times and in such places as the Council may direct.

A Board of Examiners shall be appointed by the Council; such Board shall consist of gentlemen representing Medical, Chemical, and Sanitary Science, Engineering, Architecture, and Sanitary Jurisprudence.

The Examination for Local Surveyors shall include a competent knowledge of the Statute relating to Sanitary Authorities, of Sanitary Science and Construction, and of Engineering.

The Examination for Inspectors of Nuisances shall comprise the elements of Sanitary Science, together with Sanitary Construction and the Statutes relating to the prevention of disease and the suppression of nuisances injurious to health.

Fees shall be charged for the Examinations, and a Certificate of Competence, signed by the Examiners, shall be granted to successful candidates, entitling them to be designated as "Certificated by the Sanitary Institute of Great Britain."

A Congress shall be held by the Institute for the consideration of subjects relating to Hygiene at such times and places as the Council may direct.

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Exhibitions of Sanitary Apparatus and Appliances shall be held from time to time as the Council may direct.

Fellows, Members, Associates, and Subscribers shall have the right of Free Admission to the Exhibitions of the Institute whenever they are open. All fees payable by Exhibitors and the Public shall be fixed by the Council and belong to the Institute.

A Catalogue shall be published under the direction of the Council as a permanent record of the Exhibitions.

The Institute shall take such steps as may be within its power to obtain a complete registration of sickness, especially of preventable diseases.

The Institute shall endeavour to secure the services of medical men and others specially qualified to give lectures on subjects relating to the prevention and spread of disease.

The Institute shall encourage the formation of classes for technical instruction in Sanitary Science in such a way as may seem advisable to the Council.

A Library shall be formed in connection with the Institute.

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ANNUAL REPORT OF THE COUNCIL

FOR 1883-4.

THE Council of the Sanitary Institute of Great Britain, in presenting their Seventh Annual Report to the Fellows and Members, are much pleased to record that all the statistics in the Report show a larger increase in numbers than in any previous year, and that advance has been made in the objects of the Institute, besides the financial position being more firmly established.

By the kind permission of the Board of Managers, the Anniversary Meeting of the Institute was held in the theatre of the Royal Institution, on July 12th, 1883. The chair was taken by Prof. G. M. Humphry, M.D., F.R.S., Vice-President of the Institute; and the Medals and Certificates awarded at the Exhibition at Newcastle-upon-Tyne in September, 1882, were presented by him to the successful exhibitors. Mr. W. Eassie, C.E., F.L.S., F.G.S., read a paper on "The Relationship between Geology and Sanitation." The paper will be published in Vol. V. of the Transactions of the Institute.

At an ordinary Meeting held on July 24th a paper was read by Prof. W. H. Corfield, M.A., M.D., on "The Compulsory Notification of Infectious Disease." The valuable matter relating to the working of compulsory clauses in those towns in which they are in force has been tabulated, and will appear in the Transactions (Vol. V.) The original returns, containing further information, are preserved in the Office for reference.

The Autumn Congress was held at Glasgow from September 25th to 29th, 1883, by invitation of the Lord Provost and Town Council, the President being Prof. G. M. Humphry, M.D., F.R.S. The Presi-

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dential and other addresses to the Congress, and the papers read at the Sectional Meetings, will be published in the Transactions (Vol. V.), together with abstracts of the discussions upon the papers. The London and Provincial Press contained very full accounts of the Meetings, and also commented most favourably upon the general work of the Institute.

Excursions and visits to places of interest were made during the Congress week.

The Exhibition was decidedly an advance even upon the satisfactory one held at Newcastle-upon-Tyne in the previous year. There were 130 exhibitors and 720 exhibits. The Judges awarded 18 Medals, 12 Special Certificates (to articles which had received Medals at previous exhibitions of the Institute), and 46 Certificates. Forty-four exhibits were deferred for further practical trial and testing, the result of these trials will be reported at the Anniversary Meeting in July, when all the Medals and Certificates will be presented. About 20,000 persons visited the Exhibition during the twenty-six days that it was open.

Candidates for Certificates of Competency to discharge the duties of Local Surveyors and Inspectors of Nuisances were examined in June and November. At the Examination in June eleven candidates presented themselves, four for Certificates as Local Surveyors and seven for Certificates as Inspectors of Nuisances. Two candidates were Certificated as competent to discharge the duties of Local Surveyors, and six as competent to discharge those of Inspectors of Nuisances. At the Examination in November ten candidates presented themselves, three for Local Surveyors and seven for Inspectors of Nuisances. One candidate was certificated as competent to discharge the duties of Local Surveyor, and five as competent to discharge those of Inspectors of Nuisances.

The Examinations are becoming very widely known, and the number of Candidates shows a steady increase. Besides the Local Boards and Corporations in England which recognise the value of the Certificates granted by the Institute, the influence of the Examinations is extending into Scotland, Ireland, and the Colonies.

During the year the Institute has sustained the following losses by death:—Cromwell F. Varley, F.R.S., M.INST.C.E., Fellow; Ralph Carr Ellison, and J. Laws, Members; and Matthew Pratt, Subscriber.

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Since the last Annual Meeting there have been elected 4 Fellows, 41 Members, 14 Associates, and 2 Subscribers; and the numbers now on the Roll of the Institute are 90 Fellows, 213 Members, 34 Associates, 18 Subscribers, and 30 Honorary Foreign Associates —total, 385.

The retiring Members of Council are Dr. B. Browning; James Mansergh, M.INST.C.E.; Magnus Ohren, A.M.INST.C.E.; Councillor J. A. Russell, M.A., M.B.; Henry C. Stephens, F.C.S.; and J. Ure.

In September the Offices of the Institute were moved from Conduit Street to the Parkes Museum, 74A, Margaret Street; and although the Institute has not amalgamated with the Parkes Museum, their field of labour is so similar, that this association of Offices cannot fail to be beneficial to both. The Members of the Institute have the advantage of free access to the Museum and of the use of its Library.

In accordance with a suggestion made at the Congress, a Committee has been appointed by the Council for the purpose of considering the advisability of collecting and publishing in abstract the writings of the late Dr. William Farr, F.R.S., one of the Vice-Presidents of the Institute. The Committee has made considerable progress, and hopes soon to make a communication on the subject to the Members.

The Congress and Exhibition this year will be held in Dublin, an invitation from the representatives of the leading societies and the most prominent and influential residents in that city having been forwarded by Lord Brabazon, and accepted by the Institute. The Council trust that this Congress will prove as successful as the previous ones, and that the success of the meeting will, by assisting the cause of Sanitary Science in Ireland, promote the objects and interests of the Institute, and benefit the sister country.

(By Order)

E. WHITE WALLIS,

Secretary.

74a, Margaret Street,

7th May, 1884.

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SANITARY INSTITUTE OF GREAT BRITAIN.

Abstract of Cash Receipts and Payments for the Year ending December 31st, 1883.

	£ s. d.	£ s. d.
To Balance as per Pass-Book of the Institute, December 31st, 1882:—		34 6 4
„ Fellowship Fees	31 10 0	
„ Admission Fees	45 3 0	
„ Life Compositions	99 15 0	
		176 8 0
„ Annual Subscriptions		176 8 0
„ Examination Fees...		55 13 0
„ Sale of Transactions and other Publications		69 11 8
„ Sale of Office Furniture		3 17 6
„ Congress		68 5 0
„ Loan from Members of Council		150 0 0
„ Exhibition Account		550 0 0
„ Overdrawn at Bank		16 3 2
		£1300 12 8

	£ s. d.	£ s. d.
By Expenditure:—		
Office Furniture	8 5 4	
Rent and Taxes	75 12 6	
Salaries and Wages	203 8 0	
Postage, Telegrams, and Carriage	38 7 5	
Incidental Expenses	47 17 11	
Stationery and Printing	75 14 2	
Ordinary Meetings...	9 18 10	
Examination Expenses	38 4 0	
Library	0 9 7	
Congress	231 12 3	
Transactions—Vols. III. and IV....	294 17 2	
Medals and Certificates	11 5 6	
		1035 12 8
„ Repayment of Loans—		
Members of Council, 1882 ...		100 0 0
„ „ 1883 ...		150 0 0
		1285 12 8
„ Petty Cash in hand		15 0 0
		£1300 12 8

EXHIBITION ACCOUNT.

	£ s. d.
To Balance 1st of January, 1883	258 12 8
„ Receipts	1354 11 1
	£1613 3 9

	£ s. d.
By Expenditure and Transfer to General Account ...	1109 13 11
„ Balance at Bank December 31st, 1883	503 9 10
	£1613 3 9

Audited and Confirmed,

5th May, 1884.

MAGNUS OHREN, } *Auditors.*
ERNEST TURNER, }

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ADDRESS

By Dr. Alfred Carpenter,

CHAIRMAN OF COUNCIL.

Read at the Annual Meeting, May 7th, 1884.

Gentlemen,—I find from the agenda paper that it is the duty of the Chairman of the Council to address the Members of the Sanitary Institute at the Annual Meeting. Casting about for a subject which should be appropriate without being diffuse or tedious, I have determined to be as personal as possible in my remarks, and to stick to the objects which the Promoters of the Institute have had in view in founding this association. To ask if those objects are attainable, and, if they are, why seven years have elapsed since the foundation of the Institute without a greater advance being made towards their achievement than has been hitherto effected. These objects are stated in the prospectus which was published in the report of the proceedings of the first Congress, which was held at Leamington in 1877: they were nine in number. They have been varied from time to time to a very slight degree, and are still our "*raison d'etre.*" I find among the office-bearers of to-day a considerable number of those whose names appear in the first prospectus of the Institute, and we may fairly assume that those who joined the association in 1877, and who continue to take an interest in its affairs and a share in its management, are still of opinion that its objects are attainable, and that there would be an advantage in their accomplishment. I ask, therefore, why so little has been done to secure the result which was so warmly advocated in 1877, and not repudiated in the succeeding years of our progress. I read that the Institute was established "exclusively for the advancement of all subjects relating to Public Health." I find this statement at the head of the prospectus which was then issued. The proposition then put forth contains the elements of strength, by means of which great good has been effected, but it also contains within its terms the elements of apparent weakness which have not been so fully considered and guarded against by the Members as they ought to have been.

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Those who have had the distinguished honour to be elected Members of the Institute, and have signed, or ought to have signed, an undertaking "to advance the objects of the Institute as far as it may be in the Member's power," and have agreed that they will attend the meetings thereof as often as they conveniently can, have not fulfilled their promise. This is now our Eighth Annual Meeting; we have now 384 Fellows, Members, and Associates, and scarcely more than ten per cent. are present here to-day; and I may pertinently ask whether the majority of the Members have done all in their power to promote the design we all have had in view? I will not go through the nine objects set forth in the first prospectus, for that would be both wearisome and tedious. There is no doubt about our adhesion to most of them; but I will take the ninth object, and consider it more fully than it has hitherto been done, and by its means prove that the elements of weakness which exist in the proposition at the very head of our first prospectus are elements which are positive. They have been acting very powerfully against the interests of a consolidated sanitary body, and against the full development of true sanitary work, in a manner which requires to be altered, and a different course pursued, if we are to be successful as an Institute at any early date.

The ninth proposition is stated to be:—

(9.) "To unite into one comprehensive association all the workers in these important branches of science (viz., those which are connected with the promotion of Public Health.")

A large number of our Members have forgotten this object; at any rate, it appears to have lain dormant, for other associations, having similar objects, have been founded; other institutions have been promoted for the purpose of effecting the very work which the Institute was formed to carry on, as it was hoped, to a successful issue, and by means of these we, as an Institute, have been weakened.

I am not finding fault with the work which has been done by other associations, but I am jealous of the honour, and for the honour of the Institute, that a great part of their work has not been done under the ægis of our own association.

We have not been loyal to our Institute; we have forgotten the fable of the bundle of sticks. We have, to some extent, frittered away the power which a body of scientific men like those engaged in sanitary work ought to possess, in endeavouring to promote associations which are upon a much narrower platform than that which the "Sanitary Institute of

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Great Britain" occupies. I wish to bring this state of things to the notice of the Members, in the hope that it may lead to some further step in the advancement of that desirable object which is embraced in the ninth proposition, to which I have alluded, and upon the success of which our position as an Institution depends. I have said that the flag of the Institute, by declaring that it is established "exclusively for the advancement of subjects relating to Public Health," puts forth a proposition which contains within its terms the elements of weakness, so far as is apparent to the eye, because it impedes the rapid growth of our association. A bar of gold which is alloyed with a large proportion of silver and copper may appear to have the same colour as a bar of pure gold, and be apparently much more valuable, because it is so much larger; but it is lighter in weight, taking volume for volume, and is really of less value in consequence of the amalgamation. I apply my symbol to our Institution, inasmuch as by not allowing the trading element to creep into our management we materially diminish our area from whence to enrol our Members, for it is only the conscientious manufacturers who are anxious to produce a good article and to conform to the laws of health who care to enrol themselves among our friends and supporters; whilst they who only make goods for the purpose of sale, without any reference to their fulfilling the principles inculcated by the Institute, avoid us, as likely to put a stop to their ill-gotten gains. If they appeal to us for our "imprimatur" upon their production they find that they do not get it, and, as a consequence, each Exhibition which has been held has produced a crop of disappointed exhibitors, who rail against us as prejudiced judges, and are not afraid to style us ignorant pretenders to a knowledge of sanitary science. If my information is correct, some of the disappointed exhibitors have been ready to promote rival institutions, and to use as their agents, men of eminence who have not always seen the tendency of the proposed new body. These institutions have not appeared as absolute rivals, but they have suggested lines of work which do not come strictly within the objects of the Institute, and to those lines they have added some of the lines contained in our "*raison d'etre.*" I find in most of these associations a trading element creeps in, and some manufacturing idea is connected with it. I have been associated with one or two myself, without perceiving the evil tendency which inevitably belongs to such works when it is proposed to form sanitary boards who shall operate on lines similar to those which the Institute has adopted. As soon as I saw the evil tendency of these associations I separated myself from them. I am not objecting to the work which sanitary boards may undertake to

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perform in such cases, but I would make it a "*sine quâ non*" that the employés who are appointed to superintend such works in the capacity of surveyors and inspectors should possess the imprimatur of the Sanitary Institute of Great Britain before they are appointed to the duty which they undertake in such associations, and the boards which supervise the work should consist only of men who have shown their capability to undertake such work by their having already been elected Fellows or Members of the Institute, and having signed the undertaking to uphold its honour and promote its prosperity. If we could get some tacit understanding of this kind in force among sanitary men; if we could expunge a part of our own personality, and make the Institute the "*alter ego*" of our aims in the promotion of sanitary work, putting aside, as far as we are concerned, the £ s. d. of the case: instead of being the weak and disunited body which fritters away its power in various distinct associations connected with Public Health, as is now the case, we should form the powerful institute of health which is really wanted and which should be the first authority in the kingdom upon matters connected with public health. Instead of being made the prey of some designing set of men who are looking out for the loaves and fishes on their own account, and, not getting them, then allowing the new associations to go to the wall, we might have a magnificent Institute, capable of taking its place in the State with the Royal Society, the Royal Academy, the Law Society, the College of Physicians, the College of Surgeons, and other bodies, who undoubtedly do regulate public opinion upon those points with which they are directly connected, and sometimes even advise the Government of the country upon matters with which they are intimately associated.

One important step has been taken during the past year to effect our purpose; we have migrated from back rooms in Conduit Street to a scarcely more appropriate position in Margaret Street, but by so doing we recognize the work which the Council of the Parkes' Museum is doing, and by associating and indigitating our work with theirs we are paving the way for a more intimate bond of union in the future. I may have Utopian views upon such matters, but I should like to see an Institute which should be Cosmopolitan, which should have a senate as compact as the senate of one of our great colleges, and associated with that senate the various sanitary bodies which are now separate sticks scattered abroad among the Societies of the Kingdom, and without defined boundaries of work, and which, for want of those defined boundaries, overlap each other, and devour a part of the income which belongs to each in carrying on their management at separate offices and by distinct organisations,

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when a centralised office and branch organisations would promote the object in view with tenfold vigour and tenfold effect.

This is the age of exhibitions. It has been one of the great objects of the Council to recognise the usefulness of such collections of manufactures and useful works of art; to utilise the custom for the advancement of knowledge among the people in sound sanitary directions.

The real work done by the Institute with this object has brought forth a crop of local imitators. In some instances there has been zeal without knowledge. The worldly wisdom of local managers has led them to distribute medals and other prizes and certificates with a grand disregard for useful superiority and true excellence, but with a loyal adhesion to the principle which recognises the advantage of having a friend at court. No doubt local exhibitions have helped to popularise some sanitary truths, but unfortunately error has also been favoured, and in consequence of that favour the term "*sanitary*" in many instances has been convertible into a much less noble name, which conversion has not helped to forward good work.

The evils I refer to have been very carefully avoided by the Judges appointed by the Council of the Institute, and who have performed their tedious work with a loyal disregard of self and a devotion to the principles embodied in our prospectus, which is worthy of all commendation and support, and which ought to lead the general public to recognise the true value which attaches to the awards of the "Sanitary Institute of Great Britain."

It had been the aim of some of us to promote an exhibition which should be truly worthy of the name of sanitary, and to which the inhabitants of this great metropolis might have been invited as visitors.

As the Chairman of your Council I was preparing to suggest the Council to undertake such a work when I became aware of the proposal to hold such an exhibition at South Kensington, on very broad principles. I need not say that in the face of such an exhibition, held under the auspices of those who were announced as guaranteeing its success, and who were promoters of the South Kensington Shows, the Sanitary Institute would have come off second best. I at once dropped the idea which was uppermost in my mind; and whilst rejoicing in the enlistment of the Prince of Wales in a public health demonstration, I can but regret that the awards upon sanitary appliances and general sanitary improvements had not been left in the hands of the Institute to settle, rather than that judges should be appointed to determine the merits of rival manufacturers and interested patentees, who will probably be new to the work, and

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not always capable of recognising the side issues which but too often determine the awards of medals and certificates instead of taking up the broad principles of superiority and true usefulness, independently of the sum which may have been paid for decorating space or spent in advertisements, and other means by which notoriety is to be obtained and success at some kind of exhibitions secured.

It is to be hoped that the fallacies which underlaid some of the awards at the Fisheries Exhibition may be avoided in the awards which will be made by its successor, and that the desire of the Council of the Institute that all side issues may be excluded in making awards at South Kensington, may be obtained. At any rate it will not be the fault of the members of your Council if the judgments are not approved by the after verdicts of the country and the press.

Returning to my simile of the Bundle of Sticks, I would, with great deference, suggest to the Council of the Parkes' Museum, as well as to that very useful and important body, The National Health Society, which is located in Berners Street, the National Smoke Abatement Institution, together with the different bodies who have banded themselves in so-called "Sanitary aid committees" in various parts of this great Metropolis, whether a general amalgamation, upon the broad principles which the Institute aims to accomplish, would not be a real advantage to the great cause which we all have so much at heart. Such an amalgamation would be only an impediment to the self-assertion of some, and to those who try to make capital out of sanitary cries, by which they puff their own wares or promote the sale of something in which they have a pecuniary interest. I also throw out these suggestions to the Members of the Institute, believing that it is a right direction to take. We have Members belonging to our body in every one of the important Associations to which I have referred. If my proposal should meet with general approval, I think the Members should suggest to the Council the appointment of a Committee, with power to add to their number—of course with their consent—of individuals belonging to other organisations, so that a basis might be arrived at for an active co-operation and condensation of power. We might, if such an amalgamation could be brought about, be strong enough to obtain a Charter of Incorporation from the Crown, and then persuade the Local Government Board to issue regulations that no one shall be appointed in the future to perform the duties of Surveyors and Inspectors of Nuisances until they have given proof that they know the duties which they propose to perform, and that they are able to give a reason why a given set of sanitary regulations

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ought to be enforced. Such a body would also be able to press upon the attention of the ruling powers that it behoved Medical Officers of Health to have had something more than an ordinary medical education; because such education is conducted more upon the principle of curing than of preventing disease. They would be able also to insist upon the propriety of such Medical Officers of Health not becoming the rivals of their fellow practitioners for the patronage of the well-to-do, or for the good word of the individual members of the local authorities, but would insist upon such officers not being in general practice as medical men engaged in the cure of disease.

There might then be the imprimatur of the Institute upon sanitary officials of all kinds, so that the public might discern between the quacks and charlatans and the true professors. We might then make it impossible for the repetition of such scandals as have arisen in connection with local and other exhibitions, and promote the formation of sound and healthy public opinion on all matters connected with Public Health in a much more satisfactory manner than is at the present time at all possible to be effected.

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SOME OF THE PRESENT ASPECTS OF PRACTICAL SANITATION.

ADDRESS BY H. C. BARTLETT, Ph.D., F.C.S.

Anniversary Meeting, July 10th, 1884.

PRACTICAL sanitation now presents so many important aspects, that I have to make my selection for this address from those which have lately come within my own professional experience, or those which, from their extreme gravity, have forced themselves upon my attention.

I will reverse the order in which I have just mentioned these aspects of sanitation, as we are all aware of the intense importance which attaches at the present time to the serious outbreaks of epidemic disease with which we are threatened. I say threatened notwithstanding the visitation of small-pox now serious enough in London—4,000 persons having suffered from that loathsome disease during the last six months, of whom, at the time I now speak, more than 400 have died. Shocking as this is, as an evidence of imperfect administration of preventive medicine throughout the metropolis, it is worse as disclosing the want of foresight on the part of the Government, which permits the powers of prevention, already existing under various Acts of Parliament, to remain in abeyance. We are told by the President of the Local Government Board "that it would be a good thing to concentrate the sanitary authorities of the Metropolis under one head, instead of under three heads, as at present, namely, the Boards of Guardians for vaccination, the Asylums Board for removal, and the Vestries and District Boards for disinfection." It is admitted that the actual working under these three separate authorities necessitated the delay of a week before three cases of small-pox could be securely isolated, even when these cases occurred at the "Home" of the Princess Louise. And yet this is to continue until the London Government Bill is passed, if it ever will be, although the most competent medical science predicts, with almost certainty, a renewed outbreak of small-pox in the course of next winter of infinitely greater virulence.

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Dr. Cameron prayed for preventive medicine to be enforced under the present Acts, but to be enforced with vigour, and without the present unfortunate delay. He pointed out that in Glasgow, where it is not claimed that all the arrangements and details are carried out in perfection, the annual deaths from small-pox have been reduced to 9 per million; while in London they amount to no less than 226 per million. It was shown that, before unity of sanitary action was enforced in Glasgow, the death-rate from small-pox was much higher than it then was in the metropolis. And statistics, the accuracy of which is not impugned, were given which proved that just as practical sanitation for the prevention of small-pox was more and more strictly enforced, so was the death-rate from that disease reduced, until the very remarkable results, now recorded, were attained. The lessons we learn from the good working at Glasgow are that compulsory vaccination and re-vaccination free of cost to the population is the first essential. To accomplish this we must have compulsory notification of contagious diseases which will also insure immediate and complete isolation and disinfection. In Manchester, Oldham, and Bradford, where compulsory notification is already carried out, as far as the prejudice of its opponents permits, the mortality from contagious diseases is very low. No sentimental or perverse fads can be permitted to exculpate offenders against the penal clauses of these Acts. The so-called religious resistance to the law of the land, which is so painfully exemplified in the fanaticism which resists vaccination, can no longer be partially tolerated by the remission of cumulative fines. Re-vaccination must also be made compulsory, at any cost, even if we lose the voting powers of the agitators against it, together with the whole of their following of fools and knaves.

Vaccination and re-vaccination must be always and immediately available, free of charge, and be applied freely, both to the patient when first seized, and to all persons liable to be affected by the disease having broken out at that particular spot.

I am very earnest on this point, as the latest good news concerning vaccination and re-vaccination is to the effect that in almost all cases where a small-pox patient has been vaccinated for the first time, or re-vaccinated as soon as possible after the appearance of the disease, a great and marked diminution of virulence during the rest of its course has been almost invariably the result.

It is the same with regard to the isolation. To be thoroughly effective against the spread of the disease, it must be carried out at once, and in the like manner disinfection should on no account be delayed.

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Among my later opportunities of testing disinfecting apparatus, I have made some interesting experiments as to the actual cost of thoroughly disinfecting clothes, bedding &c.

The apparatus, which is movable, is of iron; the outer shell being covered with asbestos. Between the outer and the inner casings gas jets send heated air, and the products of combustion, into the interior through openings near the top of the casing. The articles being placed inside, and the lids closed, the gas is lighted, and in twenty-five minutes a temperature of 280° Faht. is obtained, with the consumption of 75 ft. of gas.

The apparatus is 7 ft. 4 in. in length, 3 ft. 4 in. wide, and 3 ft. 4 in. deep, and can be maintained at a temperature varying from 280° to 240° Faht. for an hour by the further consumption of 40 ft. of gas. We had thus a total expenditure of 115 ft. of gas, costing a little over 3½d.

The matters tested were articles of muslin, calico, flannel, a flock cushion, some baker's yeast, and some very miscellaneous groups of fungoid spores, pus-cells, microzimes, moving vibrios, and bacteria.

In the result, the muslin, flannel, and other articles, were found quite uninjured and not at all singed, while the yeast, fungoid spores, moving organisms, and bacteria, were killed, and could not be resuscitated by moisture or treatment with Pasteur's growing solution. The yeast had lost all fermentative power on solutions of glucose after a trial of four days at 84° Faht.

With the means of disinfecting the clothes and bedding so easily available, and at so trifling a cost, there is no excuse for delay or neglect in carrying out this most important safeguard. As contrasted with the natural aversion to burning infected bedding and clothes because of the compensation which has to be made, the facility and economy of this plan of disinfection leaves little to be desired.

With the hope that a strong pressure from without may induce combined action on the part of the existing authorities, to take the required steps to prevent further outbreak of small-pox, and to restrain the spread of that which is already in the midst of us, I will turn to the other epidemic with which we are threatened.

With cholera at Toulon, which has spread to Marseilles in the beginning of July, we may well set our house in order and entrench ourselves within the almost impregnable outworks which practical sanitation affords. We have ourselves to thank if our sanitary authorities are remiss or behindhand in the year of grace 1884. We had our warning as lately as this month last year. Then it came from Egypt, and a great scare ensued

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throughout all the nations of Europe except our own. All our good neighbours could think of was quarantine upon quarantine; with a complete and abiding faith that if cholera should be on board the detained ships, it would either kill those who had taken it, or be itself destroyed by the patients outliving the disease. Very little was done abroad to stop the means of disseminating the disease in case it did make its appearance on shore, in spite of all the suffumigations and quarantine detentions. The sewers, such as they were, and are, still empty their abominations into the streams and harbours; the house drains still descend untrapped into the sewers or dumb-wells; the soil pipes, or the brick flues which frequently do duty for soil pipes abroad, still pass directly up the houses, frequently in the centre, round which the staircase winds, and are as free from the suspicion of ventilation as ever.

And the water! The water is still that curious fluid which appears to gather to itself all the floating particles, all the foul gases which can be absorbed in it, and to have had a very intimate acquaintance with the aforesaid drains, dumb wells, and sewers. We, on the other hand, evinced very little trepidation. No one suggested quarantine. No; we are too business-like a nation to think of imposing such restrictions on so important a branch of our national trade as to impede our shipping interests. We were, to a large extent, in the right. Quarantine is not a scientific means of preventing the importation of cholera, but I have a slight mental impression that it was almost as much due to the trade instinct, as to the scientific repudiation of quarantine that we owed, and probably shall owe, our total disbelief in that obnoxious and illogical means of prevention.

If it were not for some such motive underlying our superior courage as to the chances of cholera invading us, how is it that our confidence in science has not yet induced us to more largely sustain our reputation by following up the teachings of science?

We are not yet in a position altogether to deride the *laissez faire* of the Continent. Have we no rivers nor harbours into which our sewers drain? Are our sea-port towns, Liverpool for instance, free from an abnormally high death rate from contagious diseases? Yet Liverpool is, in some sense, so advanced in the unity of its administration, yet with such unsatisfactory results, as to be taken by the President of the Local Government Board, *exempli gratia*, as a sufficient reason why London should wait, until further orders from the Government, for sanitary reform.

These are our weak points, and we may find our confidence misplaced in the event of an epidemic of cholera from abroad taking its hold in any of the badly drained towns upon our sea-

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coast. But what, after all, is the chief distributor of cholera, according to our most carefully sifted statistics? No one can doubt it is the pollution of our water supplies. We have dealt with London, that is Greater London, in the brief consideration of the epidemic of small-pox. Let us bring home to ourselves the condition of London as to cholera. My friend, Dr. Collingridge, on the 2nd of this month, gave evidence before the select Committee of the House of Commons of the various outfalls of sewage into the Thames. "At Kingston there was a large outfall, two feet in diameter; at Surbiton they had two large outfalls; Thames Ditton had a very foul sewage ditch and other drains. There was a nine inch pipe close to the bridge at East Moulsey." The Chairman stopped the witness, by saying, "I don't think we need go further." Mr. Shiress Wills: "The Committee are well aware that everything drains into the Thames." Mr. Gathorn Hardy (a member of the Committee): "Nobody contends against that." This, in the neighbourhood of the intakes of some of our largest Metropolitan Water Companies, is the evidence which nobody denies. What if cholera were to break out in this largely populated district? I feel of the same mind as the Chairman of the Select Committee, "I don't think we need go further."

But if the evidence of our own carelessness is plainly, far too plainly brought before us, science is advancing, stage by stage, so that by the time we have agreed that we must at length do something, a very superior something will be found available, to anything which could have been brought to bear, if at the beginning of the investigation anything had been decided on. It is like the story of the guns and the armour-plating. We are so slow, so says a great gunnery expert, and we have hesitated so long as to what the gun of the future shall be, that we have saved untold millions of money in experiments which might have been made, and shall now, if we do not go to war for some years, be able to be—"at least on a par with other first-rate powers." So it is with the interception of sewage.

By the time we accomplish the removal of all outfalls in the neighbourhood of the intakes of our great water companies, we are almost certain to have a system of filtration perfected, which really will oxidise and purify such water from all deleterious matters. I would not venture on such a prediction if I had not to a large extent taken the well-known saying to heart, "never predict until after the event." If I had not assured myself that such a system of filtration is not only possible, but, on a comparatively small scale, has already been carried out, I should hesitate to raise hopes which had no sufficient basis.

About ten years ago I was engaged in testing a number of

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different filters, and I was particularly struck with the peculiar power of oxidation which some of them possessed. A so-called carbon-block filter oxidised the whole of the complex nitrogenous matter, in what is termed the albuminoid ammonia, and converted them into ammonia pure and simple. For five months that filter continued to oxidise all the oxidisable organic matter of various kinds contained in the 300 gallons of water which passed through it in that time. After that the filter required cleaning to remove the accumulation of sediment which obstructed the flow of water through the carbon. Every care was taken to avoid injuring the filtering medium, but I could never again obtain that perfection of result. Since then I have tested many filters, at least some hundreds, but until lately, in some experiments of my own, I have not found any filter which quite destroyed all the decomposing nitrogenous matters found in highly impure water.

In common with other professional experimenters, I have been content to analyse the water before and after filtration, taking care to pass a very large quantity of water through the filter before making the final test. It has been regarded as satisfactory if a filter removes three-fourths of the albuminoid matters, and gives a bright and nearly colourless water after a hundred gallons at least have passed through. This was considered a good result, and accepted as proving a considerable oxidising power, and if not equal to my Phœnix of filters in its pristine potency, it was deemed to have so far purified the water as to render it much more safe, and infinitely more wholesome.

Little did we know of the fallacy involved. From many years' observation, the medical profession and scientific sanitarians have issued their warnings against trusting to filters to remove any specific infective matters which may find their way into our water supply. Their fundamental axiom has been to keep the *materies morbi* from entering the sources of our drinking water. This consensus of observation and opinion has been, and is, entirely right. It is right because we can never be sure that the water will be filtered, and it is right because, until now, we could never be sure that any filter was mechanically perfect, and would remain so.

We were all aware that carbon blocks might be faulty in construction, that they might be imperfectly fixed or adjusted, that loose filtering media, of iron, or of charcoal, might be so inefficiently disposed for filtering purposes as to permit some portion of the water to pass unfiltered. We knew that if any part of the water did pass unfiltered that very portion might contain a sufficiency of the specific infective matter to be just as great a

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source of infection as if the whole had remained unfiltered. The danger is not minimised by partial filtration, it is not reduced one *iota*.

All this is as the leather and prunella to the shoemaker, it is all well known and accepted; but I must state my case.

Besides the obvious fissures in filter blocks, and water-ways which reveal themselves when the blocks are broken open, there are unseen and unsuspected direct ducts in most of the filters which form by-passes, so to speak, permitting water only slightly filtered to pass more rapidly than it would if it traversed the filtering medium as intended. And it is to these ducts or by-passes that the inefficiency of the ordinary filter is due. I have had filters running so slowly as to be practically useless, yet the water which did come through was not filtered. On the other hand, I have had filters which were by no means slow in action, and which oxidised nearly nine-tenths of the albuminoid matters, in which the remaining tenth certainly passed unfiltered by one or more minute but clear and uninterrupted water-ways. I discovered this important fact, which had hitherto escaped detection, in consequence of my faith in certain prepared carbon blocks.

I was endeavouring to take out from some water the last traces of sulphate of barium, which, as chemists know, is only to be accomplished by heating the water, previous to filtration through the finest Swedish paper. In this case I was precluded from heating the water by nature of the experiment, so I attempted to filter the barium out by passing the water through the best carbon block it had been my good fortune to possess. This block actually oxidised nine-tenths of the albuminoid matters in water, and was therefore an exceptionally good specimen. Judge of my surprise, when I found the fine precipitate of barium coming through with great pertinacity. Over and over again I found the same result, and it was some time before I could get a block which would arrest all the sulphate of barium. To prove whether this was mechanically perfect I tried one of the finest of all precipitates, phosphate of uranium, and this it also filtered out. Yet this block did not oxidise so large a proportion of albuminoid matter in water as the other block, and was not so good a filter. To see if I could improve its oxidising action, I mixed a little very fine animal charcoal with some water and passed it through, intending to analyse the water after filtration, when to my great astonishment I found a considerable quantity of the finest particles of the charcoal coming freely through with the water. After a time the water ran clear, and on analysis I found every trace of albuminoid matter oxidised or filtered out.

Repeated experiments prove this to be the solution of the

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question, but there are other almost equally unsuspected causes which render the testing of house filters merely by the analysis of the water before and after filtration sometimes misleading. Taking the matter up with great interest, I found that after water has been perfectly filtered, it is liable to become polluted to an unexpected degree by the decomposition of the cork and india-rubber washers and tap plugs. It may not be of very great importance to health, but it is unpleasant to know that two cork plugs taken out of a filter which had been in use for rather more than two years, had become so decomposed that a yellow ring of deposit was formed all round the storage chamber to a depth of about three-fourths of an inch. This, on microscopic examination, literally teemed with moving organisms; yet that filter was an almost perfect filter when the water was taken without being allowed to pass through the storage chamber. I have also found the india-rubber fittings after six months' use covered with a peculiar slime, which proved to be decomposed rubber with free sulphur. It is therefore important that house filters should not contain any kind of decomposable material.

But to revert to the essential of the filtration of drinking water, there is no doubt that this can only be perfectly effected by perfect oxidation. I am now engaged in a series of experiments to compare the oxidising power of very fine carbon, such as that which came through the carbon block, with platinum black, which is the most powerful mechanical oxidiser known. I have already progressed so far as to be able to say that no nitrogenous decomposable matter carried in water can pass through platinum black without being completely oxidised or burnt up. This, of course, includes the specific infective matters of diseases communicable through water. If we could afford to filter all our drinking water through platinum black, we could secure total and perfect immunity from infective matter in water. But at two guineas an ounce this would be an expensive luxury. I have no doubt that the extreme fineness of the platinum black is the means whereby the oxidation is effected, and for the same reason the strong oxidising power of the finer particles of carbon is probably due to their extreme minuteness. I hope to find it when used on a large scale amply sufficient to ensure the complete destruction of all albuminoid organic matter in water, including, as I previously said, the specific infection which is known to be mainly disseminated through the agency of drinking water.

So much for this aspect of practical sanitation, but I cannot conclude this portion of my address without pointing out to the public at large that they can easily test their filters for them-

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selves, to see if they are mechanically well made and fitted. Take a little of the finest powdered charcoal, which should be previously washed with hydrochloric acid to remove the lime, mix it in a cup with water, stirring it well, throw it into the filter, and if any comes through, the filter is useless until the charcoal fills up the excessive porosity. This it may do, but very frequently the fine particles continue to pass through *ad infinitum*. I am sorry to say that my own experience of thus testing the majority of filters is, that not one in ten is effecting any reliable filtration at all.

As a natural outcome of discussing the means of purifying water for the prevention of infectious disease, some recent experiences of the legal and administrative action which certain authorities have lately taken, stand up prominently before me, and are not pleasant aspects of practical sanitation.

One of these cases occurred in the northern suburb of London, where some cottages derive their water supply, partly from a well and partly from a very sufficient storage of rain water from the roofs. The latter is laid on to every house, and is nearly equal to supply all the tenants for two months, in the event of no rain falling during so long a period. The well is between 45 and 50 feet deep, steined with bricks set in cement, and fortified with a backing of concrete. The Medical Officer of Health, however, pursues a peculiar method of erecting his own standards of purity, by which he determines whether sewage does or does not find its way into the wells in that neighbourhood. He takes the average analyses of the water from a certain number of wells in the district, which are of admittedly good character. He finds from this, what he calls the normal proportion of chlorine in the good water of that locality. Other constituents are also averaged for the same purpose, but the quantity of chlorine, taken as chloride of sodium, or common salt, in any sample of well water within that urban authority is the principal evidence upon which it is passed as uncontaminated, or, if in excess of the average, it is denounced as therefore full of sewage. This is a mistake, *ab initio*, and the mistake is the greater, inasmuch as the oxidisable portion of the nitrogenous matters, the nitrites, are not separately estimated. On the data so furnished, notice was given to the occupiers of the cottages and to the owner, that the water was full of sewage and dangerous to health, calling upon the owner to lay on "a proper supply from the mains of the Company supplying that portion of the district." These proceedings commenced about four and a half years ago, and it was considered necessary to ascertain if the water from this well was so polluted as to be unfit for drinking purposes. In that case the well would have been voluntarily closed imme-

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diately. The tenants were, however, very anxious to retain the well water, which was agreeable, bright, and cool.

The analysts to whom it was submitted did not find any proof of contamination from sewage, and the Local Authority was so informed. Again and again were the notices served upon the tenants and on the owner, stating that further analyses of the water had been laid before the Authority, and that legal proceedings would be taken if the water from the company's mains was not forthwith laid on to all the cottages. During a period of more than three years this peculiar procedure was continued, keeping the lady in a constant state of apprehension that the action against her would be commenced. The Authority was informed that if they would bring the matter to an issue the owner was prepared to defend the action on the ground that the Local Authority could not prove the water to be injurious to health, and could not therefore obtain an order to close the well. Over and over again summonses were issued and then withdrawn, and at last, after nine months' more worry, expense, and annoyance, it was definitely settled by the Authority that they would proceed under the 62nd section of the Public Health Act, 1875, to lay on the Company's water under the report of the Local Surveyor that there was not a proper supply of water to the cottages. Here, it is important to observe that a surveyor can only report upon the quantity, not the quality of the water, and a "proper supply of water" is very different in meaning to "a supply of proper water."

The Local Authority was then challenged as to whether there was not a sufficient and even a superabundant supply of water already available, and to try the case under the 70th section, which gives power to close any well which is so polluted as to be injurious to health.

The abundance was admitted, but the Medical Officer declined to certify that it was injurious to health, notwithstanding all he had so often reported concerning the alleged pollution of the well from sewage.

Here was a mass of contradictions. No one had previously heard of an attempt being made to force a supply of water from the outside upon tenants, who did not want it, while they were amply supplied with rain-water, and from a well which the Authority would not dare to make application to close.

To cut a long story short, the Authority submitted another sample of the water to their County Analyst, who examined the well and surroundings, and pronounced the water to be pure and wholesome. Then another sample was sent to an Analyst, whose reports on the London water supply are often quoted, but without describing the peculiar geology of the

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surrounding soil, or informing him that this well was sunk through the Boulder clay, which contains many descriptions of glacial drift. It was, therefore, unlike most of the other wells in the neighbourhood, which are sunk in the common London clay. Not knowing the singularity of the formation just at this place, this gentleman supported the Medical Officer, by stating the water was full of sewage, and dangerous, but not injurious to health. The case was tried and the summons dismissed, the Authority altogether failing to prove that the water was unfit for drinking purposes. The last mentioned witness, indeed, contributed somewhat to this conclusion by stating, with much emphasis, "that the presence of normal healthy sewage in drinking water was not injurious to health, its only effect being to cause those who drink it to become fat." If I had not taken down the actual words at the time I should not have the courage to repeat them now.

Irrespective of this, one of the nastiest aspects of practical sanitation, it is lamentable that a local authority can, year after year, harrass and worry an unprotected lady, and put her to the expense of many hundred pounds in resisting their demands. These, when brought to an issue, at last, are found to be based upon a bad interpretation of the law, and upon certificates which could not possibly sustain their case. It can be no additional comfort to the lady to know that the heavy expenses incurred by the Authority will come out of the rates to which she is a large contributor.

There is no legal estoppel to prevent the same Authority from issuing similar summonses half a dozen times more, or, if they had succeeded in laying on the Company's water, from finding that to be an improper supply, which, indeed, it is from insufficiency, and then insisting on laying on another supply from another company having mains within the district. This phase of sanitary administration is an unmitigated hardship for all owners of wells, and the Local Government Board is inclined to admit that it is so. But the Local Government Board states it has no power to restrain the action of the Local Authority until money has been spent by the latter in so laying on the water, or until they further proceed to recover the amount from the owner of the property. In this instance proceedings were stopped and all the expenses were incurred before that stage was arrived at; and the owner could only recover the legal costs of the hearing before the magistrates—a sum of ten pounds out of so many hundreds.

Now is the time to urge householders to set their houses in order, and particularly to clean out and keep their cisterns clean. It is of no use for me to agree with Sir Robert Rawlinson,

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although I do agree with him, and say I would have no cisterns, and that "constant service by pipe and tap only, alone deserves the name of a modern domestic water-supply." We know that throughout large districts in London and elsewhere, if there were no cisterns there would be no supply of water during twenty-two out of the twenty-four hours. But the cisterns can and must be kept clean, and for drinking water let none be taken from the cistern, however cleanly it may be kept. Let every householder have a draw-off tap fitted to the rising main, which fills the cistern—the cost of this is very trifling. Glass-lined piping is used extensively in America, and, where practicable, is found better than lead or unlined iron piping. Then have a large water-can, which can easily be kept scrupulously clean, ready to fill about ten minutes after the water begins to come into the cistern. Two or three gallons is all that is required in a small family, and this should be invariably passed through a good house-filter, which has been tested with the finest charcoal and found to be mechanically sound. It is equally essential that all parts of the filter can be thoroughly and frequently cleaned. This plan obviates the want of the constant service at the least possible trouble, and it is well worth a great deal more trouble to practically abolish the cistern for drinking water. Begin with the cistern, and then see that the drains are properly trapped and disconnected. It would not, however, be wise to attempt to disturb old defective drains or cesspools at this, the hottest season of the year, but they can be so dealt with as to greatly lessen the dangers they store up. We should be lavish with our disinfectants. The so-called chloride of lime, carbolic acid, and other powerful agents are disagreeable enough, but we must put up with that if we have any old drains or cesspools, and it may be accepted as a rule that pleasant-smelling deodorants or disinfectants, and disinfectants without smell, are useless for these purposes.

Descending to the lower storey we come face to face with our old enemy the dust-bin. What can we do to overcome this grim and ghastly concentrator of garbage? Disestablish it at once, cast it away and never more permit a heap of sweltering corruption to poison the air, insult the olfactory nerves, and, may be, prove a very centre of infection. As long as there is a dust-bin, and servants are permitted to throw potatoe-peelings, cabbage leaves, and other vegetable refuse into it, we inevitably find there fish-bones, scraps of putrid meat, and all kinds of animal matter, thrown away because too disgusting to give to the dogs or cats.

The accumulation of all the decomposable matter left at table and rejected from the kitchen, even from a small family, becomes

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formidable in a week of hot weather, an intolerable nuisance in a fortnight, and a hot-bed of putrescent pestilence soon after. Yet it is not very seldom that three weeks elapses before the dustmen can be induced by bribes and threats to remove the heaving conglomeration of filth. Appeals to the vestry are always courteously received, and the contractor's men are forthwith ordered to call and remove the dust. But, somehow, it happens that they have no ladder with them long enough to reach to the bottom of the area, or their baskets are so large that they will not pass through the trap-door of the grating, although that trap-door was specially constructed to make the removal of dust and refuse more easy and less offensive. Once able to go away without emptying the dust-bin, and you have to go through the same course of application to the vestry, before you can insist upon the men doing their duty, and then, perhaps, only by allowing the men to bring the dust all through the house. These are not ideal or exaggerated statements, for they have occurred many times at my own house, and at the houses of many of my friends. It is high time, as Sir Robert Rawlinson says, that there should be "no more black-mail levying by dustmen, nor sulky neglect if their tribute be not freely paid." The most systematic arrangements should indeed be made for the removal of dust once or twice a week, and that arrangement should be made in writing and duly agreed to by the vestry. Never let the men break through the arrangement by a single day without at once sending a formal complaint, and insist upon the duty being carried out.

But to assist in this, and to reduce the nuisance to the smallest dimensions, we must adopt the very excellent plan devised by a friend of mine, a lady, the wife of an eminent physician, residing in Mayfair. It consists in this:—First get rid of the dust-bin, do not tolerate it even as a receptacle for ashes and dust. Then provide two or three small sacks, such as those used to hold a hundred weight of coals, hang them up by several cords to keep the mouths distended, and let the dry dust and ashes be placed in them direct from the dust-pans and fire-places. No vegetable or other decomposable refuse must ever be mixed with the dust and ashes, and this is essential. The dustmen find it easier to remove the dust and ashes in this way as there is no digging out of the pestiferous dust-bin, no filling reeking baskets, and the bulk is lessened by two-thirds.

Then, what is to become of the vegetable and other refuse? I find in the larger households, that if this is left to the cook, and the cook is sharp enough to take the hint, persons are to be found who will not only collect these matters daily, but will pay the cook a trifle quarterly for the privilege of so doing.

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In smaller establishments all decomposable refuse must be burnt.

There has been the difficulty, that in attempting to burn green stuff, fish bones, and other offal, in the ordinary stoves and grates, the stench becomes unbearable. We all recognise that *odeur puante* which instantly ascends all the stairs and descends all the chimneys, until everyone in the house knows that the right thing is being tried to be done, but in the wrong way. No ordinary grate or stove will burn this refuse without creating a bad smell, and most of the kitcheners and close stoves make it worse. I have, however, in the investigation of this matter, seen one close range or kitchener which burns up all kinds of refuse without allowing any unpleasant smell to escape, and that is one which has received several awards from this Institute, and is known as the Wilson range.

I have also been surprised to find an open grate of the most ordinary description, such as is commonly found in sitting-rooms and bed-rooms, made to consume vegetable and other refuse without smell, very successfully, by a simple back-flue arrangement, which is shown at the International Health Exhibition by Mr. Stobbs. Such are some suggestions, failing the best plan of all, which is adopted in Amsterdam and some Towns in Scotland. Even in Gray's Inn, London, every bit of dust and refuse is placed outside the door early in the morning and collected with less cost and trouble than is possible by the usual dilatory and dangerous dust-cart system. All these little matters of detail are apparently but trifles, yet they are so important that not one of them can be neglected with impunity. The strength of a chain is measured by its weakest link, and Public Health and wholesome surroundings can be relied on only when we are assured that there is no missing link in the chain of sanitary precaution.

Within the scope of practical sanitation comes the great food question of the day, namely, how are the poorer classes to be fed, so that they may maintain health and strength, not only to enable them to exist and do their daily work, but to defend them against epidemic disease? In our selfishness or carelessness this is a question which is not sufficiently discussed or thoroughly gone into. We are content to think of it as a matter which can be regarded from a very general point of view. We accept the fact that we have an immense number of under-fed and badly-fed persons, whom in the same general way we sympathise with, and wish they were better off. We are charitable, too, as far as subscribing to hospitals, dispensaries, and district visiting societies, and an incalculable amount of good is by these means effected. It has been left to one indi-

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vidual to take up the greatest want of the poor neighbourhoods, that of providing markets at which food can be purchased at prices not unduly beyond those which remunerate the producer. To the Baroness Burdett-Coutts is due the unspeakable advantage of striking boldly at one of the closest of food monopolies, that of the supply of fish. With the zealous co-operation of Mr. Burdett-Coutts, the fish is caught, forwarded, and sold at Columbia Market, with no middleman's profit beyond the percentage justly payable to the stall-keeper.

This is a bold and courageous attack upon trade combinations which have for their object nothing but the gross enhancement of the cost of perishable food, until it reaches a perfectly prohibitory price. If time permitted, I could lay bare the means adopted to carry out a system by which hundreds of tons of good fish are destroyed, rather than allow a glut in the market to reduce the prices to their proper level. All this, the wants of the half-starved poor notwithstanding!

I am, however, more concerned with precisely the same kind of trade combination in respect to the price of bread. In my own house, with but few to keep, and indulging in the ordinary variety of fish and meat, vegetables and fruit, our requirements for bread are but small. Whether the price of household bread is 7½d. or 5d. per four pound loaf, it would not make a difference of much more than one shilling per week. But, take the household of a labourer with the average family of two adults and four children. This means a consumption of at least of from thirty to thirty-six pounds of bread per week, and the poorer the family the greater the amount of bread consumed. A difference of one penny per quartern loaf therefore means ninepence a week, either saved by, or extorted from the poor pittance of, the hardest worked classes of the community. It is true that a still greater food-saving might be effected if the labouring population would sink their prejudices and give the cheap whole-meal or granular wheat-meal bread a fair and unbiased trial. But take them, even as they are, and let them adhere to their fancy for fine white bread; it is a most astounding fact to find that bread is sold to the poorest of the poor under the regulations of the Master Bakers' Associations, at from 6d. to 7d. per quartern. The Baker's Record, the organ of the trade, under date of the 28th of June, this year, quotes "Households, 7d.; Neville's, 6½d.; Aërated, 5½d. to 6½d.; and *very inferior qualities*, 4½d. to 5d. The real truth necessitates a fuller inquiry. With the assistance of Mr. W. Whitfield, a solicitor, who has lately had to obtain legal evidence of the underground working of these associations, I find that while the price of bread is kept up to 6d. per quartern, in the poor

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neighbourhood of Bow and Stratford, there is at least one baker there who is an independent man, and who offers to supply excellent bread in quantities at 4½d. per 4lb. loaf, full weight. I have obtained a sample of this bread, and I can professionally testify that it is as good as that with which I am supplied at 7d. for ready money. While the poor are paying 6d. a quartern at the East-End of the Town, and it will pay well to retail really good bread at 4½d. (and the poorest always insist on the quality being good), it proves that at the present price of wheat, the middle men are extorting 25 per cent. more than a handsome and legitimate profit. I ask, in the name of humanity and practical health economy, is there no other great benefactor, such as the Baroness Burdett Coutts, who will come forward and help to break down this monstrous monopoly. If any favourable response is given to this suggestive enquiry, I will personally undertake to bring forward another master baker who will guarantee to produce good bread for sale to the working classes at less than the lowest price quoted, and yet show a fair and reasonable working profit. Free trade has reduced the price of wheat until our own farmers cannot cultivate corn to enable them to pay their rent, in fact, in bad seasons it does not repay the expense of seed, farm labour, and bringing to market, irrespective of rental. Why, then, should the whole advantage that cheap wheat should afford to the poor be absorbed by the middle man before it reaches them? Why should the price of wheat have no relation whatever with the actual cost of bread, even in the poorest neighbourhoods?

Perhaps we may assume that few subjects have attained a larger public interest than the movement which has of late years endeavoured to deal with the abatement of fog and smoke. From the time when so many cattle died at the Agricultural Hall, during the show, owing to the dense fog which prevailed, there has been unanimity of evidence to demonstrate the bad economy and unhealthiness of shooting the contents of the coal-scuttle into the air. My friend, Mr. W. R. E. Coles, has kindly supplied me with a large number of facts, including an analysis of the return of convictions for offences against the Smoke Acts in the Metropolis, extending over a period of five years. It appears that the magisterial treatment of the cases was very unequal, and that the present administration does not comply with the letter—far less the spirit—of the legislation. A new Bill in Parliament will, it is hoped, carry the prevention of smoke much farther than has been possible hitherto. The universal complaint that lung disease in large towns is aggravated to a serious extent by the particles of soot which descend, in fine weather and in fog, and the detestable dirtiness which

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the so-called blacks produce, and is unique in its universality, form reasons sufficient to induce us to urge the adoption of every practical means to alleviate the evil. Measures of prevention must include penalties on the one hand, and instruction how to avoid them on the other. The latter is the main object of that excellent Institution for National Smoke Abatement, whose good work is gradually producing the best results in stimulating inventions to enable us to burn fuel without waste or smoke.

The instruction, which experience alone can give us, is being quietly reduced into a systematic form by several other institutions besides that of the institution just mentioned. We have our own good reward in the Sanitary Institute, in finding that our own examinations are from year to year more sought after. Local Surveyors and Sanitary Inspectors come in larger numbers, and more eagerly to test their efficiency before our Board of Examiners. We still find, unfortunately, that there are men already holding good positions, who come forward with a misplaced confidence, assuming that because they have the appointments they must have the knowledge to enable them to obtain our much prized certificates, without adequate study. On the other side of the shield, we are frequently pleased to find the reflection of studious men, who intelligently follow out their study in their practise, whose examinations prove them to be men of resource and knowledge, well fitting them to occupy the highest offices in the Sanitary Executive.

A great advance has been made in this respect, both by the Sanitary Institute, and by the Local Surveyors and Sanitary Inspectors, who evince so laudable a desire to be certified, and it must be taken as an evidence of a want which has long been felt. I am certain that these voluntary examinations are but the thin end of the wedge which will ultimately open up all such responsible appointments to those alone who prove their competency by their certificates.

Credit must also be given to the Board Schools, if we are to take as a sample the written examination of May Austin, age thirteen. This youthful aspirant to practical sanitary knowledge sends in her paper from the Rea Street Board School, Birmingham, and is of Standard VII. In answer to the question, "What special points would you think of in choosing a house?" answer, "Dryness, light, good air, good water, and good drainage." In delineating these "principal points," the descriptions are so terse and full, so complete, and leave out so little of what is essential, that unless the whole examination and teaching is the cut-and-dried result of mere *memoria technica*, nothing could be more satisfactory. If May Austin can reply on paper equally

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well to half a dozen more questions coming equally within the scope of our own examinations, and pass a by no means more difficult "*viva voce*," I feel bound to admit to myself that I, as an examiner, must pass that very clever little girl—certainly as a Sanitary Inspector, and perhaps as a Local Surveyor.

Passing from the room in the Health Exhibition in which this examination paper is shown, I came upon one of the methods of teaching; it is labelled—"List of apparatus for object teaching." The case contains a few articles for making the earlier rudimentary experiments in physical chemistry: a spirit lamp, an evaporating basin, a wire tripod, a watch-glass, and a few other well known accessories to the simplest lecture-table, are enclosed. But these are supplemented by a printed ticket, which states, for the instruction of teachers, that "many articles in every school-room may be used in addition to the above; thus, the tongs will serve for holding larger objects in the fire, and, if a pestal and mortar be needed, the poker and shovel will answer the purpose." This exhibit must be an elaborate joke—a comic aspect of science-teaching by the Great School Board of London—and is charmingly suggestive of the calibre of such teaching.

If I have brought forward no grand conception of the Sanitary future; if I have been unable to generalise upon the whole condition of the Sanitary present; if I have afforded no history of the time past in Sanitary progress, it is because I was specially invited to deal with the subject as a practical one. It is also that I should not have had the temerity to occupy so much time for any other purpose.

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Congresses held by the Institute.

LEAMINGTON, 1877.

President.

B. W. RICHARDSON, M.D., LL.D., F.R.S.

Presidents of Sections.

Section I.—EDWIN CHADWICK, C.B.
" II.—GEORGE WILSON, M.A., M.D., F.C.S.
" III.—R. BRUDENELL CARTER, F.R.C.S.

STAFFORD, 1878.

President.

EDWIN CHADWICK, C.B.

Presidents of Sections.

Section I.—B. W. RICHARDSON, M.D.. LL.D., F.R.S.
" II.—HENRY DAY, M.D., F.R.C.S,

CROYDON, 1879.

President.

B. W. RICHARDSON, M.D., LL.D., F.R.S.

Presidents of Sections.

Section I.—ALFRED CARPENTER, M.D., M.R.C.P.Lond., C.SS.Camb.
" II.—CAPTAIN DOUGLAS GALTON, R.E., C.B., D.C.L., F.R.S.
" III.—G. J. SYMONS, F.R.S.

EXETER, 1880.

President.

THE RIGHT HON. EARL FORTESCUE.

Presidents of Sections.

Section I.—PROF. DE CHAUMONT, M.D., F.R.S.
" II.—R. RAWLINSON,, C.E., C.B.
" III.—SIR ANTONIO BRADY.

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NEWCASTLE-UPON-TYNE, 1882.

President.

CAPT. DOUGLAS GALTON, R.E., C.B., D.C.L., F.R.S.

Presidents of Sections.

Section I.—DENIS EMBLETON, M.D., F.R.C.S.
" II.—H. LAW, M.INST.C.E.
" III.—ARTHUR MITCHELL, M.A., M.D., LL.D., F.R.S.

GLASGOW, 1883.

President.

PROF. G. M. HUMPHRY, M.D., F.R.S.

Presidents of Sections.

Section I.—PROF. W. T. GAIRDNER, M.D., LL.D
" II.—PROF. T. ROGER SMITH, F.R.I.B.A.
" III.—R. ANGUS SMITH, P.H.D., F.C.S.

DUBLIN, 1884.

President.

SIR ROBERT RAWLINSON, C.B.

Presidents of Sections.

Section I.—T. W. GRIMSHAW, M.A., M.D.
" II.—C. P. COTTON, M.INST.C.E.
" III.—CHARLES A. CAMERON, F.R.C.S.I.

The next Congress of the Institute will be held at Leicester, commencing Sept. 22nd, 1885.

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CONGRESS AT DUBLIN.

SEPTEMBER, 1884.

PAPERS AND DISCUSSIONS.

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CONGRESS AT DUBLIN.

INTRODUCTION.

THE Seventh Congress of the Institute was held at Dublin from September 30th to October 4th, 1884, an invitation signed by nearly all the influential and official residents having been sent to the Council and accepted during the meeting at Glasgow.

The buildings placed at the disposal of the Congress by various Societies were particularly suitable for the meetings. The President's Address was delivered in the Lecture Theatre of the Royal Dublin Society. The Provost and Senior Fellows of Trinity College granted the use of part of the College for the Reception Room and Sectional Meetings. The Lecture to the Congress was delivered in the Antient Concert Room, Great Brunswick Street.

The Inaugural Address to the Congress was delivered by SIR ROBERT RAWLINSON, C.B., on Tuesday evening, DR. ALFRED CARPENTER presiding in the absence of PROFESSOR G. M. HUMPHRY, President of the last Congress.

The Lecture to the Congress was delivered by DR. ALFRED CARPENTER, on Friday evening, and as no lecture was given to the working classes during the Congress a number of free tickets were issued for this Lecture.

The papers submitted to the Congress were divided as usual into three sections, each section commenced on a separate day, but so many papers were received leading to important discussions that it was found necessary to continue the meetings of Sections I. and II. on the days following.

A paper read in Section I. upon the object and work of Ladies' Sanitary Association excited considerable interest, Countess Spencer and many other influential ladies attended the meeting.

On Tuesday morning a breakfast was given by the Institute, to which the Secretaries of the Congress and Secretaries of Sections were invited to meet the Council of the Institute.

A public luncheon was held at the Exhibition Buildings on Tuesday afternoon, THE RIGHT HON. THE LORD MAYOR presided, and

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welcomed the Institute to the City of Dublin, and afterwards formally opened the Exhibition.

A Conversazione was given at the Mansion House by THE RIGHT HON. THE LORD MAYOR, on Wednesday evening, at which there was a very numerous attendance.

On Thursday evening the Congress Public Dinner was held at the Shelbourne Hotel. SIR ROBERT RAWLINSON, C.B., President of the Congress, took the Chair, and was supported by The RIGHT HON. EARL SPENCER, Lord Lieutenant of Ireland, and THE RIGHT HON. THE LORD MAYOR. (An abstract of the speeches will be found on page 421).

The Royal Zoological Society of Ireland gave a breakfast to the officers of the Congress on October 3rd.

Two Excursions arranged for Saturday, one to the Vartry Waterworks, and the other to Great Southern and Western Railway Works, Inchicore, proved very interesting, but were not largely attended.

The Exhibition was held in the spacious buildings of the Royal Dublin Society, at Balls Bridge, and remained open until October 18th. There were 134 Exhibitors and 900 Exhibits. The Judges awarded 1 Silver Medal presented by the Exeter Gas Company, 13 Bronze Medals, 11 Special Certificates, and 64 Certificates; the Special Certificates being awarded to Articles which had received Medals at previous Exhibitions. Thirty-nine Exhibits were deferred for further practical trial and testing; the result of these trials will be reported at the Anniversary Meeting, in July, when all the medals and certificates will be presented. About 35,000 people visited the Exhibition during the nineteen days that it was open.

On Saturday, October 4th, an Evening Fête was held at the Exhibition, and an adjoining Hall was decorated and fitted up for the occasion through the exertions of a Special Local Committee. About 4,000 people were present: the proceeds of the Fête were devoted to the hospitals in Dublin.

The Entertainment proved so successful that it was repeated with some modification on the Monday evening following.

At the closing Meeting of the Congress it was announced that the Council had accepted an invitation to hold the next Congress in Leicester.

E. WHITE WALLIS,
Secretary.

March, 1855.

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Officers of the Congress.

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INAUGURAL ADDRESS

By Sir Robert Rawlinson, C.B.,

PRESIDENT OF THE CONGRESS.

By Royal Commission, dated the 9th September, 1879, the Queen, in the terms of that Commission, for divers good causes and considerations, deemed it expedient to order that there should be a full inquiry in Dublin into the sewerage, drainage, and general sanitary condition of the city and of the state of the River Liffey, and for this purpose nominated Robert Rawlinson, Esq., C.B., and Francis Xavier Frederick MacCabe, M.D., to make such inquiry, and on Tuesday, the 30th September, 1879, at the City Hall, the inquiry was commenced, and was taken intermittently through fifteen days, ending Thursday, 13th November.

The evidence and report having been since that time in possession of the Corporation need not further be mentioned, other than for reference as I may deem necessary.

Since the year 1879 the Corporation of Dublin has taken in hand and carried out various sanitary improvements in the regulation of room-tenements, improved scavenging, improved abattoirs, and in improved labourers' dwellings. The purification of the River Liffey is, however, a work which remains to be accomplished.

I will not attempt to describe all the improvements undertaken by the Corporation and the local Sanitary Associations, as I anticipate details will be furnished in papers to be read before the several Sections at this Congress.

We shall have the great pleasure of listening to the Addresses by Dr. Grimshaw, the Registrar General for Ireland; by Charles D. Cotton, Esq., C.E., Engineering Inspector of the Local Government Board of Ireland, and by Charles A. Cameron,

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M.D., City Analyst and Superintending Medical Officer of Health for Dublin. These gentlemen preside over the three Sections into which the work of the Congress has been subdivided.

Sanitary science is as old as literature—that is, we find references to laws and regulations for preserving health in the oldest books known; as in the third book of Moses, LEVITICUS, and the reasons for some of the ceremonial regulations may even now be easily understood, such as avoidance of unclean meats and isolation of contagious diseases—leprosy for instance—leprosy in the person, in garments, in sites, and in houses; the regulations for the purification, by burning, of leprous-tainted garments, and the pulling down and removing the materials of leprous houses may, with advantage, be adopted by Christian communities in all countries. There are at this day what may be termed leprous sites, produced through ages of continued pollution by human excreta, upon which stand leprous-tainted houses, and in which dwell their wretched inhabitants, having about their persons leprous-rags as clothing. That something akin to leprosy exists in sites and in houses may be inferred from the fact that in our great towns, London certainly, hospital surgeons recognize types of disease, and these the most malignant and deadly, as coming from special streets, and even from special houses; and when, to accomplish certain improvements, these houses, streets, and inhabitants have been removed, that type of disease ceased. This terrible condition, under which causes of disease, both infectious and contagious, undoubtedly exist, has not been fully recognised, so as to be provided against and prevented. We shall, I trust, hear something practical from some of our members as to the necessity there is for a readier and fuller notification of the outbreak of certain diseases which are known to spread with great rapidity when neglected.

On the other hand, one of the greatest works to be accomplished by sanitarians will be to stem the torrent of sanitary ignorance now working so much mischief, and causing incalculable human misery, without in any useful degree lessening the fearful evils existing.

Quarantine, as now practised, works at enormous money cost as well as incalculable inconvenience, and produces much misery without preventing the effects intended to be warded off. At this day quarantine is rigidly in force over the southern nations of Europe, but cholera, the disease so dreaded, is not prevented. The Italian Army is placed on guard at the frontiers, and the strictest quarantine regulations are cruelly enforced at ports and harbours; but within the lines—and almost simultaneously—cholera appears, at Spezia, at Milan, at Turin,

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at Naples, and at Rome, with a probability of its raging from the Alps to the Adriatic. Quarantine has not, in these cases, served any useful purposes, either at Marseilles, at Toulon, or at Naples, but fumigations and confinement in lazarets have caused much misery, as also much mischief, by confining the healthy and by aggravating disease. The seed-beds of cholera have not been cleansed; the crowded tenements have not been lime-washed and ventilated; the filth-sodden, corrupt surfaces and subsoils remain occupied, and polluted water is used; the unventilated courts are there, and unwholesome feeding is continued. Houses and clothing in these overcrowded districts swarm with vermin. A cordon of armed men attempting to shut out cholera from such areas is attempting the impossible.

Those of our English medical men who have had the widest experience of cholera in India declare that this disease is not dependant, in the sense usually understood by quarantine promoters, on moving human intercourse, that it is not conveyed in ships from one port to another, and that it is not contagious, strictly speaking, neither does it always affect the apparently foulest sites in a district. In India the natives, at special seasons, travel from long distances in great numbers to worship at certain shrines, they are poor and ill fed at starting, they suffer extreme fatigue by travel, and undermine their health by night and day exposure to the elements, they drink impure water, the result being that cholera breaks out amongst them; when,—untended and uncared for, they perish. The poor feeble native when fatally smitten makes little complaint, but draws himself together, covers his head, and without audible groan, like a stricken creature, uncared for, dies. The poor pilgrims have suffered for days and nights—hunger, thirst, and exposure, only to end their journey by death from cholera, whilst resident natives housed on polluted sites, in filthy hovels, feeding on poor food, and drinking impure water; because they are not so worn by travel and starvation do not take the disease—do not die of cholera, so that it would appear that to foul sites and an unclean population there must be added a worn and exhausted constitution.

Plague has been apparently banished from Great Britain, but still prevails in the cities of the East. In these great countries murrain first breaks out amongst cattle. It is noted that in Chinese cities, preceding any outbreak of plague or cholera, the rats turn out of their hiding place in the sewers, stagger about, and die.

Cholera is said to have been known in China, as in India, from time immemorial, long before the commencement of the Christian era. It was attributed to demons, to mere pent-up

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airs which gave rise to vomitings and purgings, and was divided into two forms or kinds, the wet and dry—in the latter, the most fatal type, there is neither vomiting nor purging, and this is the most deadly form of cholera at the present day. There are records, many of them mythical—commencing several thousand years ago, and reaching down to the present date—recording destructions by the elements: as earthquakes, floods and famines, followed by plagues and pestilences. The living not having been sufficient to bury the dead. The great powers of Nature, for destruction, have not ceased, though dormant. Modern research has indicated that the crust of our globe is in an unceasing tremor, subject as of old to earthquakes and tornadoes. This little favoured spot of the earth's surface called England is not free from warnings.

It is not necessarily the duty of sanitarians to teach the doctrine that dirt and disease are in all cases cause and effect, neither is it their duty to declare that they are not. Dirt is to be removed or avoided; disease is, as much as possible, to be prevented, and so far as human agency extends men should strive for a sound mind in a sound body.

I do not suppose that, however much sanitary science may aid in the promotion of comfort and in the reduction of disease, it will ever carry its votaries to the verge even of full prevention, as there are cosmical causes which have been, are, and ever will be, beyond human control. Excesses of heat, excesses of draught, and excesses of cold, have destroyed vegetable, animal, and human life over vast areas of the earth's surface almost to extinction, and there is nothing more certain than that cosmical changes in the seasons similar to those which have occurred in the past will be repeated in the future. We know nothing of the origin of life. We move at the bottom of an atmospheric ocean over which we have no absolute control; the composition of which, in bulk, we cannot alter. We find health under certain conditions; malarial disease and death under others, and how little can we affect these elements one way or the other! Let us note what are the elements we have to consider. The sun furnishes heat to evaporate the ocean water, and out of these elements proceed our meteorological changes. The vapour, invisible at first, forms into cloud, which again condenses into snow, hail, dew, and rain, precipitating these over ocean and land. Clouds aggregate and brew up tornadoes and tempests, to settle down into the gentle and refreshing shower and breeze. All the pure water in springs, streams, rivers, and lakes, has been cloud-conveyed from the salt ocean to the sources and sites where we find it.

England is a small island, situate under a temperate climate,

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having a wondrously varied stratification, a comparatively pure atmosphere, and soil almost entirely free from malaria. Her population is, in the main, orderly, sober, and industrious; her wealth, the greatest ever heaped together on any similar area of this earth by labour. There are more and better formed roads and richer cultivation, than in any other country of the world, ancient or modern, and every child born into the land, and every immigrant who cares to reside in it, is, in a degree, heir to the whole; nevertheless, after 1884 years of Christianity, what a beggarly account in our town slums and country cottages do we find! We may congratulate ourselves on our wealth, on the ability of our statesmen, on the purity of our Judges, and on our municipal self-government, and on our colonial empire; but we have much to be ashamed of, and much to amend in our social economy. This Congress meets for the purpose of considering these defects in the body politic, and also for considering how best to devise and apply further remedial measures. Something good has been accomplished, but much remains to be done.

A review of errors in belief and in practice ought to teach us charity to our neighbours, as also how to avoid making similar mistakes in the future.

This establishment of quarantine on the continent, for instance, is both a cruel and a costly proceeding. It is established in ignorance, and is worked in selfishness (reason apparently cannot teach, but self-interest may). It is stated that the bankers this summer (1884), have issued some four millions of pounds sterling less than usual to continental travellers, in circular notes; and I think we may assume that a much larger sum will be lost to the inhabitants generally, by fear, by sickness, by premature deaths, and by losses in diminished trade on land and water. Premature deaths such as cholera produces, verging upon a cholera scare, are costly all round, costly in a way and to an extent only approximately to be estimated, but it may fearlessly be asserted that if money to the value of the losses inflicted by quarantine, and by cholera, had in the first instance been applied to sanitary works and regulations would have gone far to sewer, drain, and cleanse every foul cholera-smitten city on the continent.

In commenting on cholera it must not be forgotten that this disease is not so destructive as the ever present fever under its various forms. Typhoid is answerable for far more deaths than cholera, and there are also nameless diseases which run their course: the sins of the fathers being visited upon the children to and beyond the third and fourth generations.

Before leaving this reference to cholera I cannot refrain

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from referring to a despatch from Sir Edward Malet on some features of the cholera epidemic in Egypt, 1883.

Writing from Cairo, August the 6th, 1883, he says, "I have almost daily visited different parts of the city and its suburbs, and there is hardly a district with the condition of which I am not more or less familiar. It is, however, simply an abuse of words to talk of sanitation in connection with Cairo, every sanitary law being grossly set at defiance.

"The canals are, in many instances, little better than sewers, and no precautions, at least none deserving the name, are taken to keep the sources of water-supply free from contamination by excreta and filth.

"Conditions for the development and spread of disease in almost every form, epidemic or otherwise, abound. They are here, there, and everywhere, present to sight, smell, and taste.

"The Medical Department stands in great need of thorough reorganisation, and as to a Sanitary Department, I am not aware that such a thing exists."

The above remarks are strictly speaking only applicable to the defective Egyptian sanitary arrangements, but nevertheless it is disgraceful that so severe a sentence on our own army medical administration in Egypt could be written, as is to be found in the blue-book on the failures in the Army Medical Department in Egypt of last year,—after the experiences of the Crimea,—after the Army Royal Commissions, inquiries, evidence, and recommendations,—after the establishment of Netley Hospital, and the able, zealous, and earnest teaching of the late Dr. Parkes,—after the published suggestions and recommendations of the Army Sanitary Committee, the medical breakdown is astonishing. It must be said that the war department had learnt nothing, but the fault has not been so much in the medical department as in the army organisation. Sanitary science has not been believed in at headquarters or thought to be necessary, and its professors must have been considered unworthy of notice. The army sanitary commission sent out by the government of the day in the spring of 1855 to the British Army in the Crimea, found the hospitals on the Bosphorus destructive pest-houses, and the army before Sebastopool fever and cholera smitten; the Commissioners were credited by the Prime Minister (Lord Palmerston), to the generals and admirals, and were armed with full powers to hire labour and provide material for hospital-cleansing and ventilation, and within three months they so cleansed and ventilated the hospitals as to banish malarial fever. Cholera lingered sporadically throughout the camp during the summer; but, nevertheless, by the end of the year the entire

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British army was in better health than it had ever been at home, and continued in good health to the close of the war, when the French had some 40,000 men down in typhus fever—Turks, Sardinians, and Russians suffering largely from typhus also.

On the return of the British army after the war, commissions of inquiry were ordered, which resulted in barrack improvements and great reduction in army mortality both at home and abroad, but especially in India.

The results of the recent Egyptian Campaign show, however, that at head-quarters nothing practically has been learned—but continental nations and North Americans were not slow to learn the sanitary lesson taught by the Crimean Commission.

The outbreak and prevalence of cholera in Egypt last year, and in France and Italy this year, may teach a useful lesson if properly interpreted. "What is cholera?" "What are the prime causes of its prevalence in certain districts at uncertain seasons?" I, individually, will make no other reply than that "I do not know." But that cholera breaks out for a time, and prevails where there is excess of dirt, and that it also attacks and kills immoral people, impure livers and dirty people are facts well known; but it does not by any means kill all these, and as an illustration of the progress of epidemics, I remember once watching the forest leaves falling in early autumn, after a night's frost, coming down in showers. It occurred to me to consider why all the leaves did not fall at once, as all were similarly exposed; but then the fact became evident, that the weakest stems gave way first, then those which had more vitality perished gradually, one after the other; until the trees stood leafless and bare. So of disease in the time of an epidemic, the weakest sicken and die first; those who have more strength enduring the longest. Then, cholera does not prevail in all places, and sometimes, apparently, not even in the visibly dirtiest places, or amongst the dirtiest looking people in the same town; these are facts well known to medical officers and inspectors of nuisances. The outbreaks and the ravages are apparently arbitrary, so much so as to baffle understanding. Where there are correct maps of districts or of towns, on which cholera cases and deaths have been plotted, it will be seen that the disease has been of a character erratic and partial. The black spots representing deaths are in patches; some close together, others wide apart; the intervening clear spaces being apparently, on examination, just as bad as where the mortality has been greatest. If we imagine that on such a site there had been scattered in isolated patches grains of gunpowder, resting harmless until the spark necessary to explosion fell amongst

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them, and that then the explosion extended so far and no further than the sparks fell or the grains of powder were in contact, we should have results not unlike those which take place during explosions of cholera. This form of illustration is no doubt very imperfect, but may serve as an illustration of what is a difficult question, namely, What is cholera, and how is it propagated? That occasionally it is epidemic we know. That it is contagious, in the sense imagined by the ignorant, experience does not prove. It is, however, at times sporadic, taking individuals here and there, now and then, who may frequently be resident wide apart. Unsound meat and impure water may be factors in causing cholera, but not the sole cause, as these are ever present, and many who die of cholera are not water-drinkers. In some outbreaks the most destitute portion of the population has not suffered, whilst the artizan class has. The very poor in summer lived mostly in the open air and drank water; the artizan slept in an unventilated tenement room and drank beer. The outcast escaped, the artizan died.

Much has been most ably written about cholera by men like the late Dr. Farr (whose name I mention with the most profound respect), who obtained their information from official returns, but had little if any actual out-of-door experience of the disease. Hence conclusions have been drawn from tabulated statements which, when tested, have been proven to be fallacious. Cholera certainly prevails, in excess, on the margins of rivers where there are large sea-port towns, having aggregated, badly housed, immoral, and closely-packed populations; not, however, because it has any special preference for rivers as rivers, but because the element of human life is there. The same may be said as to stratification and elevation. Cholera may select low, wet, sodden, and corrupt subsoils occupied by a dense population. But where there are populations at high elevations zymotic diseases at times prevail, as both cholera and yellow fever have occurred in tropical climates at three and four thousand feet above the level of the sea. Then, as to stratification, a French commission, some years ago, came to the conclusion that cholera could not prevail upon granite. The question was put "Have you, in France, dense populations living on granite?" the answer was "No;" the reply then was "Few people, little or no cholera." Facts, when obtained, clearly shew that to have an epidemic you must of course have population, and there must also be a something in the air breathed, in water drunk, and in the subsoil, or on the surface, out of which cholera can generate when its spark, as in the case of the gunpowder illustration, is applied. But in all ages, and in all cases, where we

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have the records, as a rule excess of dirt and excess of disease have been and are associated, whilst, in wide-spread and specially fatal epidemics, there have been other conditions, such as a preceding drought and famine, or a series of wet and cold seasons, affecting and corrupting vegetation, bringing on disease in cattle and men. Devastating wars have ever brought on famine, fever, plague, sweating-sickness, cholera, and death in excess.

Having indicated a few of the probable causes of cholera, let us see if simple remedial measures can also be indicated. Modern sanitary science may dictate for cities *main sewering* and *house draining*, with *improved water-supply*. But will such costly works when executed and left alone prevent cholera? we fear the reply must be "Certainly not," they are its foundation; but without other costly works of street-forming, paving, channelling, and persistent continuous good scavenging, most of the expenditure may have been wasted, as disease will continue to haunt defective and overcrowded room-tenements and unventilated houses. In some large seaport towns the poor live below the ground water-level; but in cities like Glasgow, Edinburgh, and Dublin, the poor live in tenement-houses and attics, so that sewering, draining, and scavenging is of little avail unless something further is done in the way of excreta removal, water-supply, and cleansing. In Dublin there are main-sewers and drains with a full supply of water for the better classes; but, at the time of my inquiry (1879), for the poor who lived in room-tenements, there was no useful drainage, and practically no useful supply of water. There was no privy accommodation for the occupant of a room in a Dublin tenement, and there was no water but at an external stand-pipe, situate at a distance, involving labour to fetch and carry. A medical officer, when asked how the sick poor managed in the long nights of winter, replied "They use any utensil handy;" and when further asked as to their supply of water in the day time, the reply was "a use of the same vessel for the water." But Dublin is not by any means exceptional, as the town-houses, room-tenements, and country-cottages all over Great Britain, as also, so far as my reading goes, over every portion of the world which is inhabited, are more or less filthy and swarming with vermin, because overcrowded, uncleansed, and underventilated. Of a truth, this question of house accommodation for the poor is the question of questions both for philanthropists and for statesmen, as here are the breeding dens of the roughs of all countries, nations, and tongues, the seed-beds of disease and revolutions.

The saying that "cleanliness is next to godliness" must

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not be taken as an axiom which cannot be disputed. That cleanliness has not been and is not now, in many countries, considered necessary to godliness, religious ceremonials, both heathen and christian, amply prove. Nations professing Christianity do not to this day practise cleanliness as ordained by Moses, and explained in Leviticus. But the Levitical laws,—which inculcate cleanliness,—indicate the existence of filth and filthy habits amongst the populations for whom they were devised. The Jews, as a nation, were not road-makers or bath-builders, as were the Greeks and Romans in their day of governing power; neither have we in Great Britain public baths which can rank with those which existed in Imperial Rome, though recently baths in private houses are becoming common, and public baths and wash-houses have been and are being established by our principal municipal authorities.

In mediæval times Christianity became answerable for several forms of insanitary practices; as, for instance, intramural interments to an extent perfectly shocking. Burials of the dead took place in churchyards and within churches, in the subsoil and in vaults, to an extent which seems almost incredible. Churches which, when first erected, stood on the surface of the ground, have, during the lapse of time, by repeated burials, assumed the characteristics of cellar-dwellings, the burial-grounds having been raised by old coffins and human bones several feet in height above the original level. Within the body of these old churches vaults have also been constructed and coffins piled tier above tier, until the lower strata has been crushed by the weight above, and the vault-floor has become covered with a mass of putrid human remains. The Burials' Act passed by Lord Palmerston has caused old burial-grounds to be closed and new cemeteries to be established, so that this form of pollution has been diminished.

In India at this day dirt and holiness are in alliance; in food, and drink. Take the following extract from Reports made to the Government of Madras (1882). The description refers to certain religious rites performed by pilgrims at certain temples or shrines.

"The pilgrims depend almost entirely for their meals on the Temple Prasadum, which is in a sanitary point of view anything but satisfactory. This sacred meal, which is offered for sale at a very cheap rate, is quite unfit for human consumption. One-third of this meal is composed of some dirt and remnants of obnoxious insects. The Prasadum is also composed of unboiled or half-boiled rice, not clear of the bran, gravel, or grit, and the cakes are made of the same materials, with the addition of old, and rotten ghee. The cakes are kept for days before they are

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consumed; it is, however, obligatory on the part of every pilgrim to eat a portion, at least, of this sacred Prasadum, on account of its being an offering to the deity, and it is a sacrilege on the part of anyone even to examine the same whether it is good, and blasphemy to say that it is bad."

The water used by the pilgrims is from a tank which has been used by pilgrims for years, for washing, bathing, and drinking; thus, it is very injurious to the health of the pilgrims.

The shrines of saints are numerous over the whole of India, and the ceremonial practices are for the most part dirty.

High-caste does not in all cases denote purity, but rather rank prejudice. High-caste natives will not wash in water filtered by Europeans, nor drink it, but must have tank or river water, however polluted and dirty. A native servant was observed partly to fill his skin bottle at a Calcutta filtered-water stand-pipe, and then go to the nearest puddle to fill up the remainder. When asked what he did that for, he replied, with a grin, "Making Ganges water for master."

In this Address, I may be expected to offer some practical remarks on the most recent advances in domestic sanitary science.

It it is now some thirty years since I first prepared a set of Suggestions for the instruction of Sanitary Engineers, which have been accepted and applied in Great Britain and on the Continent, in British Colonies, in British India, and throughout North America. As I have recently revised these Suggestions, I propose to refer to them in this Address, to give it practical value.

Houses should stand on a dry subsoil, and, in all cases, for the cottage, as for the palace, the area within the walls should be covered by a layer of cement concrete.

Sites for houses should not be dug into the side of a hill, unless the subsoil is drained, and the main-walls are effectively isolated by a ward or wide area from the high ground behind.

All house-walls should, at the foundation, or immediately above it, have a damp-proof-course to prevent rottenness, which leads to the Levitically described leprosy.

Sewers and drains should not be formed within the basement of houses or buildings, private or public, small or large.

To every room in a house there should be means for fresh air ventilation.

To every room to be occupied, day or night, there should be means for external daylight.

Dry refuse should not be stored near any dwelling-house, but should be removed at short intervals; refuse liable to become

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putrid should be removed at once, and there should be unceasing day by day scavenging.

Villages, where the cottages are apart, cannot with advantage be sewered as houses in towns are; but they may be surface-drained, and have earth-latrines, to be cleansed each week by a paid scavenger. The payment of one or more shillings per week to a selected resident labourer or more in proportion to the number of cottages.

A clean water-supply is necessary for country cottages. Springs of water may, in some cases, be brought from a distance cheaply by pipes to the centre of the village. The economy of such process may be thus illustrated:—A gallon of water weighs 10lb. Five gallons of water weigh 50lb., and 365 times 50lb. for one year, and for 50 cottages in a village, would require this weight, with the weight of the can or bucket added, to be carried from any spring. The total weight being about 900 tons. This water, if piped, will flow to any convenient point and save to the villagers so much labour. This is a question for the consideration of Boards of Guardians and Landlords. I have recently seen in North Wales, on the estate of H. D. Pochin, Esq., J.P., several small isolated farm-houses fully supplied with water brought half a mile by a pipe ½ inch in diameter.

Town-sewering and house-draining are too complicated in character to be fully described in an Address such as I now deliver.

A water-supply to a town should be general. The source should be pure. The water (unless from a spring) should be filtered and stored in covered reservoirs. The supply should not fall below 15 gallons per head of the population; it should be at high pressure and constant service. Hand-carried supplies should not be tolerated. There should be full and ready appliances for fire-service.

It is practicable to take a supply of water into every yard, every house, and every room-tenement, and to supervise and manage these services so as to reduce waste and bring about economy. This, however, can only be done by unceasing supervision.

One difficulty to be contended with will be the thoughtless improvidence of the poor, and in some instances their mischievous disposition and dishonesty, as pipes of lead may be stolen. Wrought-iron-tubes may, however, be used for house-services, as they are both cheaper and stronger than lead, and the metal, having no value, will not be stolen. And water under pressure, if mischievously tampered with in any tenement, will be so disagreeable that those who wilfully liberate

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it will soon close the tap, or, if damaged, cry out for repairs, and will not again readily bring upon themselves the flooding and trouble. There are many towns in England where each cottage has an independent service of pure water at its own taps, constantly on, at a rent-charge of one shilling and even less each quarter.

Where water is brought in there should be drains and sinks to remove the waste-water. These sink-pipes should not in any instance enter drain or sewer direct, but deliver outside over a small gulley-head connected with a drain.

Town-sewering, sewage-utilization, and river and stream purification, are complicated questions in which there have been many mistakes, and out of which has arisen much litigation; they cannot be discussed in these brief remarks.

The true purpose of town-sewering should be to remove all waste-water as generated; to insure a dry subsoil, and so to dispose of sewage as not to cause nuisance.

Town-sewering is a modern science now in the course of maturing, and there are already several volumes published on the subject.

There were drains and sewers in remote periods, but only for special purposes—as to remove waste-water from temples and palaces—in Roman cities there were, however, town-sewers; but even in Rome, and in Roman cities, houses were not drained systematically. We do not find any such remains, which we should do if they had ever existed.

The extent of the Roman Empire is better known by ruins of buildings and fragments of buried pottery than by any written records; but amongst these ruins we do not find street-sewers and house-drains such as will be found by antiquarian researches at some future day under the mound—sites of ruined and overthrown British and European towns.

Main-sewering, as now inculcated and practised, only dates from about the year 1845.

Dr. James Johnson, an eminent physician of London about the year 1829, returned from Rome, and made himself acquainted with the then main-sewers of London, and, in a written description, remarked as under:—

"If the arms of the Clonca-Maxima extended to many or even all the streets of the Eternal City, the purification of Rome, by means of common sewers, can have no comparison with that of London. Neither in ancient nor in modern times did the sewers of the street communicate with the houses except in very few instances."

The oldest sewers in English, Scotch, and Continental towns

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were arched-in watercourses—or substitutes for polluted ditches —excretal and other refuse being thrown out on to the street surface; which, if paved, was of the rudest character, uneven, and full of holes. The floors of the houses bordering such lanes and streets were littered with rushes; there was no systematic scavenging, so that house-floors, lanes, and streets were covered with a layer of putrid garbage; and it was in such towns, lanes, streets, and houses that plague (the black death) found its victims. Many continental and eastern towns are in this condition at present—hence excess of disease always, and at intervals plague and cholera.

Great mischief was done about the year 1850 by the chief engineers of England reporting on the main-sewering and draining of London, where large sewers and large tributary drains were considered right and proper, and were consequently recommended for all places. The report containing this recommendation, and denouncing a use of earthenware pipes for sewers, was distributed over the continent, and was made a text-book by some engineers. Hence the large sewers of Paris and Brussels. The law was laid down that main-sewers must be sufficiently large for men to enter, and the bottoms must be flat, to enable men more readily to cleanse them. No tributary house-drain was to be less in diameter than twelve inches, and must be formed of bricks.

About 1852 I drew up fresh rules for main-sewering and house-draining, recommending that sewers should be proportioned to the special work they would be required to accomplish.

Natural watercourses were not, as in old Rome and in the City of London, to be formed into sewage-conduits.

Surface-water was to be as much as practicable discharged by the ordinary watercourses at and over the surface.

Neither sewers nor drains were to be laid within the basements of houses.

House-drains were to range from four to six inches in diameter, and were in all cases to be of earthenware-pipes or of cast-iron.

The main-sewers were to be laid in right lines and have true invert gradients; at changes of line or gradient, manholes or lampholes were to be formed, with moveable covers on the small sewers, and side-entrances on the largest class of sewers; these arrangements are to facilitate inspection and cleansing by flushing. Sewers and drains to be fully ventilated.

Any town sewered and drained on these principles is, for all time under the inspection of the surveyor. The sewers being true in line, can, from manhole to lamphole be seen through. At the surface, the line of sewer can be sighted from manhole

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to lamphole, so that the surveyor knows exactly where to sink to find a side-junction.

In the modern sewers side-junctions are to form part of the first construction, so that house-drains may join without any charge of any sort for making such junction.

Under the old system of sewers no line was kept, but the trenches were opened out in short lengths, and the sewers were constructed irregularly, both in line and gradient. Side-junctions were not formed, neither are they formed now on some of the metropolitan parish sewers, which are not under the general law, but the sewer is broken into, and the builder pays a fine for making the junction which ought to have been ready for use as part of the original construction. One effect has been that hundreds of large west end houses in London have never had the sewer opened to make the house-junction; so that the result has been house basement-flooding, typhoid fever, and premature death.

It may reasonably be thought that this mal-arrangement only needed to be pointed out to be remedied, but, unfortunately, prejudice and pocket influence are not easily got rid of. Truth has a slow growth, whilst ignorance is a weed which strikes a deep tap-root, and is not easily destroyed.

Sewer and drain-flushing with water is necessary to preserve these conduits clean. The Automatic flushing-tank must therefore be used for cleansing drains and sewers. These flushing-tanks—the invention of Rogers Field, one of the leading members of this Institute—have, therefore, become an absolute necessity. They accumulate any water turned into them up to the capacity of the tank, which may be from 50 to 500, or even 5,000, gallons, when, without further intervention, the entire volume of water is liberated at a regulated speed to flush the sewers or drains connected. The tank after each discharge fills again, and repeats the flushing operation at regulated intervals. Service-boxes (small tanks), for flushing water-closets and urinals, are constructed on similar principles.

Sanitary science is progressive. It is being studied by engineers both in Europe and in North America. In design and execution there are improvements, and, in some instances, the opposite. The complications connected with town-sewering are, however, so many and so various that definite rules to fit all places cannot be formulated. The problem cannot always be in the form of a rule-of-three sum; that is, rainfall, area, and main sewer capacity.

A sanitary engineer should, of course, be a meteorologist and a geologist; but then, why not also a botanist, as sewage developes strange growths. The engineer will study meteor-

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ology to learn the laws of the seasons; times, and volume of rain falling, not however to learn how large the sewers must be to remove the greatest volume of water falling in the least time, but how this water has passed away heretofore from the surface to be sewered, and with what effects.

Engineers, having much practice, will deal with each area specially, and construct their works so as best and most cheaply to accomplish the desired purposes; namely, to receive and remove waste-water and human excreta to some outlet or outlets, where they may be made harmless. Some engineers have thought that the heaviest known rainfall of a district must be provided for; hence, calculations have been made as to capacities of sewers to remove some exceptionally heavy volume of rain within the hour; but if this rule were worked to; main-sewers even in our climate,—for such populations as Birmingham, would have to be as large as railway tunnels. And for cities in India, such as Calcutta, Bombay, or Madras, main-sewers of the dimensions of railway tunnels would not serve; because rain occasionally falls at a rate of one inch per hour for many hours in continuance. The rule may appear absurd to those who have not studied the subject; namely, the heavier the rainfall, the less the capacity of the main-sewers should be, as, during the period that such heavy rains continue, the entire surface is swamped—sewers, drains, and streets being alike under water.

In countries subject to these heavy falls of rain, there may be, and usually are, long intervals of excessive heat and dry-weather, when at such times large sewers could only have a small volume of highly-concentrated sewage flowing through and evaporating rapidly, leaving sewage-sludge to putrify and give off deadly gases. Sewers and drains in tropical climates must therefore be confined, in cross-sectional dimensions, to moderate volumes not exceeding from 50 to some 150 gallons per head of the population. House-drains in no case need exceed four inches in diameter; and for establishments containing one thousand persons, a drain of twelve inches in diameter will be sufficient.

In England, some towns having populations up to ten thousand have outlet-sewers from 15 inches to 18 inches in diameter, and these sewers have been working during the last thirty years, and have neither choked nor burst. Surface-water has not, however, been admitted. For valley-lines down which in former times flowed surface-water—small brook courses—the culverts must be of capacity to carry off flood-waters, there must also be overflows to the river, or there must be pumping-power to lift and discharge such storm-water above flood-level. But in these cases these surface-water-channels

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ought not to receive sewage. This should be removed by intercepting-drains.

This is a most important law which ought never to be disregarded; namely, do not enclose natural watercourses for main-sewering purposes, because the volume of surface-water flowing down a small brook will be dry, or nearly dry, for long periods; whilst in storms it may be an angry rushing torrent, so that during all dry periods, sewage if turned in would stagnate, evaporate, and leave all the slimy deposit to corrupt and become dangerous. That which is true for a tropical climate is in a lesser degree true under any other climate.

About the beginning of this century, when water-closets began to be used in better class houses in London, large coarsely made brick-drains ramified the basements of houses, and were connected with the flat-bottomed sewers. Sewage—that is, waste-water and excreta, was turned into the sewers, and becoming putrid, foul gases were generated, which pervading the houses, produced fevers to so serious an extent that house-drain connection with sewers direct was forbidden by Act of Parliament. Then came in the crowning evil—the cesspool. Houses having water-closets were ordered to sever the connection with the sewers, and cesspools were formed in yards and gardens, and beneath basements, to receive the contents of the water-closets; and to this day large foul brick drains and cesspools exist beneath large old houses in the metropolis and at mansions of noblemen and gentlemen throughout the country. How many premature deaths have been the result it is not possible to enumerate. This mal-arrangement was headed by Windsor Castle, where previous to 1849 there were within the basement 51 cesspools full and overflowing. At Gwydyr House—the first Board of Health in 1848—nine cesspools were found within the basement, all full and overflowing. At Bowood, the country seat of Lord Lansdowne, the entire basement was ramified with sewers, along which men could walk upright; all of them containing sewage deposit. This was the condition of the seat of Earl Grey at Hawick; then there were leaking brick-sewers and drains at Spencer House, St. James', London; at Marlborough House; the house of the Marquis of Bristol, St. James' Square; and at Claremont. These palaces and houses have, however, been thoroughly and effectively drained, and are now in good condition. The great colleges at Oxford were in a similar foul condition, but Christ Church, Balliol, All Souls, Jesus, and Wadham, have been fully drained at a cost of about £5,000; and some 800 of the lodging-houses have been improved, cesspools and foul drains removed, new water-closets and new drains put in, impure wells and pumps done away with, and

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water supplied from the public works at a cost of some £15,000. The population of Oxford is about 40,000, and the rateable value some £200,000. The city has been sewered and drained, and pumping engines, with a sewage farm, established at a cost of not less than £200,000, so that Oxford has expended within a a few years this large sum of money on sanitary works. Cambridge, however, remains, with all its colleges, an undrained, river-polluted cesspool city. Up to about 1821, Paris was an undrained city of open privy cesspits and street pollutions, when an Ordnance was passed compelling the construction of water-tight and so-termed hermetically sealed cesspools, which continue to this day—nuisance creators and disease breeders. Neither London nor any other English town has ever been cesspooled as Paris is—that is, by such large and costly underground structures to receive human excreta, and as a consequence, the smaller English cesspools have been more easily got rid of; and, since 1848, they have been abolished by tens of thousands, so that London, at this day, stands sewered, drained, and freed from most of its cesspools, and is in this respect the most fully water-closeted and cleanest great city in the world. The work of entirely freeing the river Thames of sewage from Teddington to the North Sea, is merely a question of time, and there will be no further tampering with the question in London. The river Liffey must also be purified, and intercepting-sewers, having a sea outlet, will be the cheapest remedy. Every large town in Great Britain which is situate on the seashore, or on the margin of a salt-water estuary, at present sends the crude sewage direct to the estuaries or to the sea, and I know no valid reason against it. There are undoubtedly manurial elements of value in crude sewage, but if it must cost thirty or more shillings to utilize it by deposition with chemicals, or in land irrigation, to earn twenty shillings, and it causes no nuisance in the sea, I fail to recognise that to dispose of it in this manner at a less cost in rates is waste.

There are two modes by which inland sewage may be treated to prevent its becoming a nuisance—by disinfection and precipitation, and by broad irrigation. Now, according to the most recent experiments on a practical scale, continued over a series of years, it has been found to cost about £3,000 per annum to disinfect and precipitate the sediment from two millions of gallons of sewage per day, and the material obtained by precipitation has no paying value.

To treat the sewage of the metropolis, 160 million gallons per day, by chemical precipitation would cost, at a similar rate, about £240,000 per annum, and if carried on at the existing outlets on the Thames would create a great nuisance. £240,000

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at twenty-five years purchase would equal a capital sum of six millions sterling, which had better be expended in taking the sewage to sea, rather than in further attempting to deal with it inland

For broad irrigation for London sewage there should be some 40,000 acres of land available, which, at £100 per acre, would cost four millions sterling, and might cost four more millions sterling to drain, form roads and irrigation conduits; but no such area of land could be purchased for so low a price, if preceding examples are to be a test. It has been found that when land for sewage irrigation purposes has been taken compulsorily, the price has, in some cases, mounted up to 150 years' purchase, and is never less than three or four times the ordinary selling or letting value for ordinary agricultural uses.

Inland towns and villages, as a rule, are obliged to secure land upon which to effect sewage purification. A long list of such towns and villages might be made out, the chief towns being Birmingham, Wolverhampton, Doncaster, Nottingham, Bedford, Leamington, Oxford, Reading, Warwick, and Croydon; to name all would be to incumber this Address with a long list of mere names, which can be found in Parliamentary returns, and which is being added to. There are other towns, such as Manchester, Leeds, Wakefield, and Bradford, where sewage is partially removed by sewers and partly by movable pails, and is treated by chemicals to cause precipitation. Irrigation, or filtration through land, produces the purest effluent, and, where suitable land can be procured at a fairly agricultural price, at the least cost to the community.

On the Continent there is sewage irrigation at Dantzig, which has been in use some years, and on a large scale it is being adopted in Berlin, where there are areas of flat surfaces of land with sparsely occupied sandy subsoils. To utilize sewage in the easiest and cheapest manner, the sewage should flow on to the surface without pumping. The subsoil should be porous, the climate should be dry, and have a large average of sunshine. From such land good management would produce a profit; but the question of sewage treatment and river purification is far too large to be further discussed in an opening address before a mixed audience.

Public baths, washhouses, disinfecting-apparatus, mortuaries, abattoirs, and a scavenging department are all necessary.

Public baths, washhouses, and disinfecting apparatus, should be as near the population for whose uses they are intended as may be practicable. They should be plain in appearance, inexpensive, and fitted up with efficient apparatus. If twenty thousand pounds has to be expended in any town, for the

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benefit of the poor, it will be wiser to construct ten separate establishments placed where they are most wanted, rather than to erect one or two imposing-looking buildings to which the poor will not go—one reason being that they may be too distant. Examples of the utter breakdown of grand and costly baths and washhouses can be given, the people for whom they were intended would not use them, and so the money they cost was wasted.

Disinfecting-chambers should be attached to washhouse establishments, but isolated. That is, infected clothing should be received and washed apart. To stamp out contagious disease, burning or disinfection of infected bedding and clothing should be prompt, and it will be the cheapest process to disinfect, wash, cleanse, and restore the articles to the poor owners free of cost rather than retard the disinfecting process by using compulsion and demanding payment; as, in this case, there will be secretiveness and opposition; in the other case, ready compliance and thankfulness.

Mortuaries and ambulance-conveyances are an absolute necessity in towns, and should be a part of every establishment.

Public abattoirs, situate in open spaces, well drained and ventilated, are necessary. Private slaughter-houses ought not to be permitted.

A fire establishment is necessary; and in towns having a population exceeding 100,000 there may be several stations having electric communication with the head establishment.

Scavengers' Department. This, I consider, a prime necessity. All forms of scavenging should be under the absolute control of the municipality. There should be no private scavenging. To require householders at any time to scavenge their own premises is a remnant of barbarism, as when it is so left it never has been done, nor ever will be done. Scavenging should be at short intervals, and every spadeful of refuse should be cleared from the streets daily, being taken to some depôt. Such of the refuse as will burn should be burned, and other forms of refuse should be harmlessly disposed of outside the town or city. It will be a mistake to retain any refuse which is liable, by keeping, to become offensive, in the hope of selling it to make a supposed profit, as it is not the business of a scavenger to sell refuse, but to produce cleanness. In seaport towns, if refuse cannot otherwise be disposed of, it may be sent out to be sunk at sea in hopper barges.

Hospitals have been much discussed in recent years, and there have been great improvements, both in their construction and management; but with improvement there has been much extravagance. The prime purpose of a hospital should be to

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afford temporary shelter to the poor and injured; and that hospital relief should be of practical use to the greatest numbers; the buildings should be cheap in construction, and the administration economical. It must surely be gross extravagance to build grand palace-like hospitals costing from £1,000 up to £2,500 per bed on which to treat a sick or injured man who never earned half the amount of his bed's rental when well; and to make matters worse, these extravagantly costly hospitals not to be wholesome.

An hospital to be of the greatest use should be on a dry site, well ventilated, and out in the open country. The construction should be cheap, the space large, the means for ventilation abundant. Warming by hot-water or steam may be admissible, but warming by heated-air transmitted through flues never; as it is not wholesome. Open fires and open windows will be best; and, in summer, verandahs for patients will be of great advantage. There are new hospitals near Berlin where the beds, with the patients, are moved into the open air on fine days throughout the summer.

For contagious diseases sheds of wood, which could be burned at intervals, would give the best results, and, if saving life is the prime use of any hospital, would be most economical. In such hospitals, even in surgical cases, the greatest bungler could not kill; whilst in some of the grand town hospitals, the most expert surgeons cannot save. This has been said by an eminent physician.

I do not attempt in this Address to enter at any length into the details of the reduction of disease by sanitary works and regulations. Sir James Paget, in his recent address before His Royal Highness the Prince of Wales, at the opening of the Health Exhibition at South Kensington, gave chapter and verse setting forth great money savings by prevention of cases of sickness and premature deaths. In all ranks of life, from the Royal Family to the poorest household, it has been shewn by Edwin Chadwick, C.B., the father of modern sanitary science, that there has within the last twenty years been on the entire population a great reduction in cases of sickness. In the Army and Navy the saving is from 17 in each 1,000 to 8½. In India from 69 per 1,000 to 20, and it is hoped further reductions may be accomplished.

In looking over the advances made in sanitary science, it must never be forgotten that to undertake and perfect good works is one thing, but that to maintain them good is the main thing.

It must also be remembered that sewers, drains, and waterworks are only means to an end—they are only good so long as they are sound, clean, and cared for. Again, the most complete

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works of sewering and water-supply may leave untouched the slums and room-tenements; and these places may remain nests of contagious disease; out of which will continue to stalk the grim forms of Typhoid and Cholera. There are towns in England where sewers and drains have been formed and a good water-supply established, but where scavenging and single room tenement-inspection and cleansing have been shamefully neglected. The first should be done; the latter not left undone.

This question of sanitary improvement is an all-round question; it embraces the entire nation, as no rank or station is exempt from disease. Fever strikes down the highest in the land as the most lowly. A nation may be wealthy, and yet be unhealthy. Richly-endowed colleges may impart learning to the select few, but in town-slums vicious habits are much more profusely engendered; leading to vice and crime.

In the world there is no value but in human life, and human life has the greatest value when healthy and moral. It is the aim of the members of this Congress to induce improvement, to show statesmen and the public generally that the only safety will be in assisting to remove causes which lead to sickness, incapacity, and premature death.

The strength and glory of a nation is not in standing armies and ironclad fleets, but in the health, well-being, and contentment of the people.

The Lord Mayor—I have the honour to move a vote of thanks to our worthy President of the Congress for the very interesting anc instructive address to which we have listened; and there is one incident, of which you have all been witness, that entitles Sir Robert Rawlinson, in an especial degree, to your vote of thanks, and that is that through temporary ailment he has been obliged to call on his friend Dr. Carpenter to continue the discourse which he, Sir Robert Rawlinson, with a chivalry and disregard to self, had intended to deliver. Gentlemen, that address, lengthy and instructive as it is, each of us can bring to our respective homes—this much of it at least—that is, the recommendation of personal cleanliness and the constant removal of filth from the neighbourhood of our houses. He has very wisely told us that the strength of a nation is in the health and well-being of its people—that health is only to be attained by attention to those sanitary laws which, if neglected, bring their own punishment. I feel very great pleasure in moving that the unanimous thanks of this distinguished assemblage be given to the President of the Congress, Sir Robert Rawlinson.

Dr. Moore, President of the College of Physicians.—I will not

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occupy your time at this late period of the evening further than to follow what the Lord Mayor said about the very instructive address we have heard. But I cannot let this opportunity pass without saying that I know we in Dublin are very deficient; yet, if we look at Dublin impartially, drive through its purlieus, with which I am well aquainted, and then go back a quarter of a century, we must come to the conclusion, as I have done, that it is not in such a deplorable state as some people imagine. Gentlemen who know Dublin will remember the condition of the Coombe 15 or 20 years ago, and contrast what it was then with what it is now. There is no city anywhere where the artisans are housed in more cleanly homes, or where they have a better water supply, than in the Coombe. I know we have a great deal yet to do, but I think the sanitary authorities of Dublin have done their work fairly well during the last quarter of a century. I beg to second the vote of thanks.

Sir ROBERT RAWLINSON, C.B.—I am extremely obliged for the vote of thanks that you have passed to me, through the intervention of his lordship, and before I separate from you I will say a few words. It is known to most of you, that I was sent by the British Government in 1879 as the head of a Royal Commission to enquire into the sanitary condition of Dublin, and to report upon its sewerage, its drainage, and the state of the river Liffey. I and my colleague, your townsman, Dr. MacCabe, sat a number of days, heard evidence, and made a personal inspection. The report has been published, and I may say this, my Lord Mayor, that your Corporation gave the Commission every possible support. We had access to every document that could give us instruction, and if we did not make a useful and practical report it was not because we had not the elements for such report put before us by the Corporation. I do not wish to say one word that would paint Dublin in colours blacker than it deserves, but it would be a very hopeless case if any of us, individuals or communities, reached that point when they thought that there was nothing more to be done. I may say whatever has been done in Dublin in the past, whatever money you have laid out in sanitary improvements, I am bound as an honest man to say, and I tell it to you in all sincerity, that you have a great deal left to do yet. I do not speak thus of Dublin specially, but I say it of every town community I am acquainted with, from London down to the pettiest place I have inspected. No town has yet been made perfect, and therefore the order of sanitation must be, "Unceasing work, unceasing care, and unceasing attention to securing cleanliness." Men labour from morning to night to accumulate wealth. If they laboured one-tenth part as earnestly to accumulate health they would be wiser and happier men. Sanitation (as I have said previously) is an all-round question, and the improvements connected with it cannot come from below—they must come from above. What is the use of you or me going into the slums of Dublin or those of any other city, and looking at the wretchedness, dissipation, and vice, and standing from morning till night appealing to these poor people and preaching at them to house, clothe and live better? They cannot build whole-

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some houses in sewer and drain-polluted cities; and if the highest classes will not voluntarily forego some of the wealth they accumulate and give some attention to enabling these people to be healthier, happier, and to live better, then you may depend upon it there is a stratum of vice and misery now existent, which if made desperate by famine and neglect, would be quite sufficient to overturn all that is above, and if this state of things should continue for any length of time you may have social disturbances like the French revolution of the last century, which upset society from top to bottom; I hope we may all take this to heart, and strive to do the best we can for ourselves individually, as well as for the poorer neighbours who are about us.

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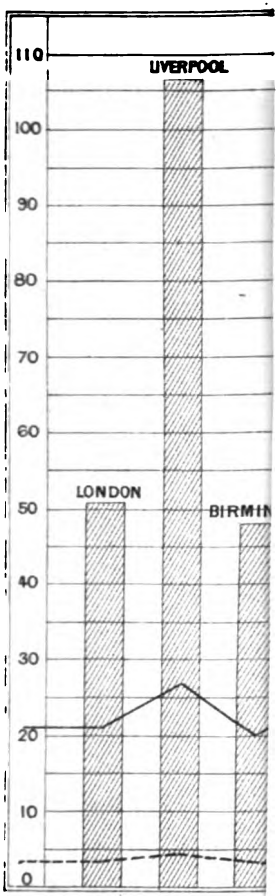

Density of population ▨.
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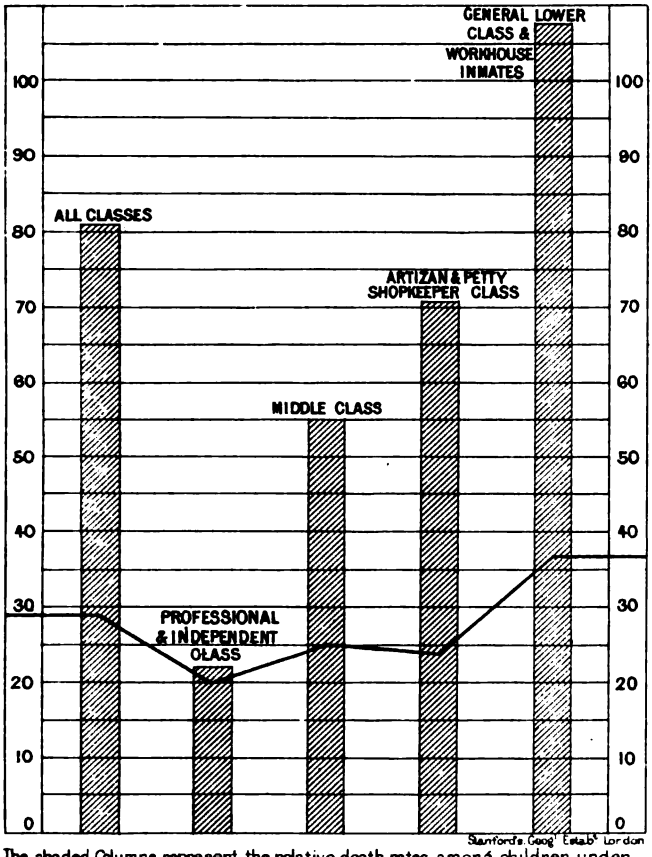
DIAGRAM. ILLUSTRATIVE OF PORTIONS OF TABLES V, AND VIII, RELATIVE TO THE DEATH RATES IN EACH SOCIAL CLASS OF THE POPULATION OF DUBLIN.



The shaded Columns represent the relative death rates among children under 5 years of age in each social class. The continuous line, the death rates at all ages. The marginal figures indicate death rate per 1,000 living.

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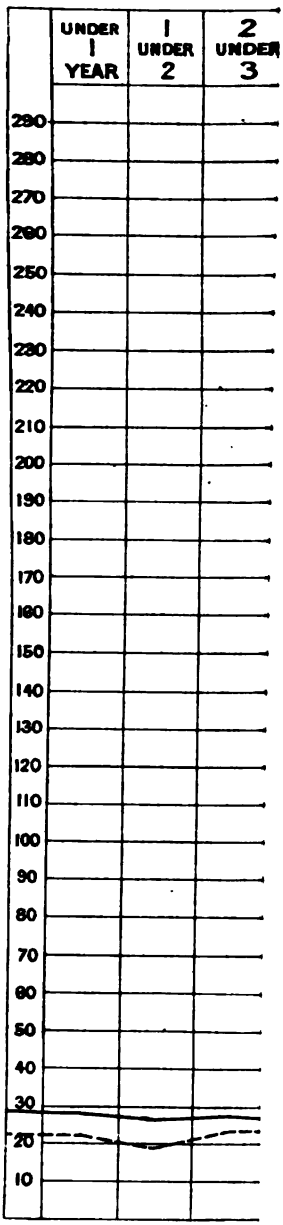

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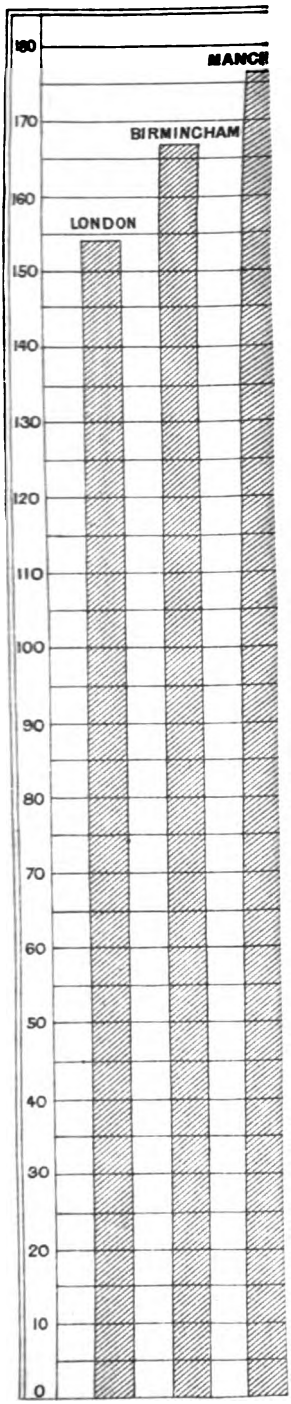

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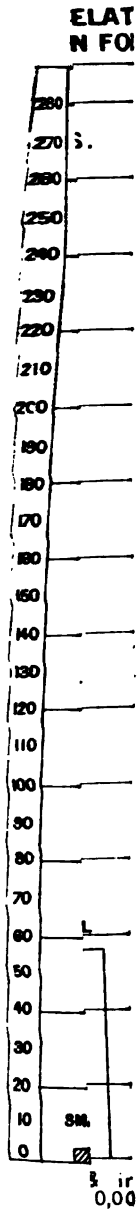

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SECTION I.

SANITARY SCIENCE & PREVENTIVE MEDICINE.

ADDRESS,

By Thomas Wrigley Grimshaw, M.A., M.D.,
Registrar-General for Ireland,

PRESIDENT OF THE SECTION.

I have to thank the Council of the Sanitary Institute of Great Britain for the honour they have done me in selecting me to preside over this important section of the Congress.

It would be impossible to state what subjects might not be included under the comprehensive title of this section, namely, "Sanitary Science and Preventive Medicine." Fortunately the organisers of the Congress have arranged for two other sections, which relieves this one of dealing with *all* the subjects comprised under the term sanitary science. I need scarcely say that with such a wide expanse of subjects before me, there arises some little difficulty in selecting one which would be acceptable to the section, and which at the same time I might claim to discuss with some authority. I propose to address you on the subject of "Statistical Measures of the Health of Communities."

In the absence of any system of recording the prevalence of *sickness*, the only way we have of arriving at a general estimate of the health of any district is by making use of the information afforded by the number of the deaths among its inhabitants, the nature of the diseases of which they die, and the relative proportion of the causes of death to the total, and to one another, and their relation to other conditions with which I desire specially to deal on this occasion. A death rate does not necessarily indicate the amount of *disease* prevalent in a district; for instance, there are some diseases, such as influenza,

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which cause but few deaths, but which may almost suspend the activity of a population. We must look therefore to other means of measuring the *sickness* rate, and this can only be partially done. Many are sick who do not know it, or who take no notice of it for a long time, and there is not yet any method of recording the sickness that is known. Indeed, it is improbable that any reliable record of sickness will ever be established. Nevertheless, many very effectual attempts have been made to estimate the extent to which sickness prevails in certain communities, especially with the view of discovering data upon which to make rules for the working of sick clubs and benefit societies. In an address by Sir James Paget, delivered in connection with the International Health Exhibition in London, this subject has been dealt with in a singularly able manner, and illustrated by a series of statistics admirably compiled and ingeniously arranged by Mr. Sutton, whose ability in such matters is worthy of the highest praise. By the kind permission of Sir James Paget, I am in a position to make use of Mr. Sutton's valuable figures for your benefit. Sir James Paget said:—*

"It is a common expression that we do not know the value of a thing till we have lost it; and this may be applied to the losses of work which are due to losses of national health. There are very few cases in which these can be estimated with any appearance of accuracy; but I am helped to the best within our present reach by Mr. Sutton, the Actuary to the Registry of Friendly Societies. In his office are the returns for many years past, of the sickness and mortality among the members of a very large number of these societies; and, among other things, there is recorded the number of days for which each member, when 'off work' on account of sickness, receives money from his society. Hence Mr. Sutton can estimate, and this he has been so good as to do for me, the average number of days' sickness and consequent loss of work among several hundred thousands of the workmen and others who are members of these societies. From the entire mass of these returns he deduces that the average number of days' sickness, per member, per annum, is very nearly 1½ weeks; and this agrees, generally, with the estimates made in other societies by Mr. Neison and others. But the average thus obtained includes the cases of members of all ages, and among them many cases of chronic sickness and inability to work during old age. In order, therefore, to get a better idea of the actual annual loss of work through sickness, he has calculated the average annual number

* British Medical Journal, Vol. I., 1884, p. 1191.

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of days' sickness of each person during what may be deemed the normal working time of life; that is, between 15 and 65 years of age. This he has done among the members of the large group of friendly societies known as the Manchester Unity of Oddfellows; and then, on the fair assumption that the rates of sickness of the whole population during the working years of life would not be far different, he has calculated the following tables, showing the average annual rates of sickness of each person enumerated in the census of 1881 as living between the ages of 15 and 65.

TABLE I.

Ages.	Number of Males: Census of 1881 (England and Wales).	Weeks' Sickness per annum, according to the experience of the Manchester Unity.	Average Sickness per Individual per annum (in Weeks).
15 to 20	1,268,269	844,428	·666
20 „ 25	1,112,354	820,183	·737
25 „ 45	3,239,432	3,224,134	·995
45 „ 65	1,755,819	4,803,760	2·736
All ages from 15 to 65	7,375,874	9,692,505	1·314

Ages.	Number of Females: Census of 1881.	Weeks' sickness per annum, according to the experience of the Manchester Unity.	Average Sickness per Individual per annum (in Weeks).
15 to 20	1,278,963	851,701	·666
20 „ 25	1,215,872	896,685	·737
25 „ 45	3,494,782	3,476,146	·995
45 „ 65	1,951,713	5,368,229	2·751
All ages from 15 to 65	7,941,330	10,592,761	1·334

Briefly, it appears from these tables that the average time of sickness among males during the working years is 1·314 weeks—that is, a small fraction more than nine days each in each year—

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and that among females it is yet a small fraction more. The result is that, among males, there is a loss of 9,692,505 weeks' work in every year, and among females a loss of 10,592,761 weeks. Thus we may believe that our whole population between 15 and 65 years old do, in each year, 20,000,000 weeks' work less than they might do if it were not for sickness. The estimate is so large that it must, on first thoughts, seem improbable; but, on fair consideration, I believe it will not seem so. For the members of the Manchester Unity, who are in the working time of life, the reckoning is certainly true, and it is founded on the experience of between 300,000 and 400,000 members. In respect of health, they may represent the whole population at least as well as any group that could be taken. They are not very strictly selected; they are not picked lives; yet they are such as are able, when they are in health, to earn good wages or good salaries; and, as their prudence in joining this association shows, they are comparatively thrifty and careful persons. They do not, at all events, include many of the habitual drunkards, the cripples or utter invalids, or those who, through natural feebleness, or early disease, or mere profligacy, cannot earn enough to become members or maintain themselves in membership. Neither do they include many of the insane, or imbecile and idiotic, of whom there are, in our population, nearly 70,000, doing no work, and losing not less than 3½ millions of weeks' work in the year."

No further proof is necessary of the great loss the community suffers from sickness, and therefore as death statistics are practically our only measure of the prevalence of sickness, and the only generally-available statistical measure of the health of communities, it is of the utmost importance that we should know the exact value to be attached to these measures, and the fallacies to which we are liable in making use of them. Most of you—indeed, I think I may say all of you—are familiar with the paragraphs which appear weekly in our newspapers announcing that the death rates of such and such towns are so many per thousand and with similar statements, recurring quarterly or annually, for the whole of each of the three divisions of the United Kingdom and of their various subdivisions. Thus, if the following list be examined, we find that, among the great towns of the world, the death rates, taken upon an average over a series of years, vary from 19·9 in Christiania to 48·0 in Madras :—

Calcutta	30·9	Paris	26·4
Bombay	34·8	Geneva	22·6
Madras	48·0	Brussels	25·4

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Amsterdam	25·9	Trieste	34·1
Rotterdam	26·1	Rome	28·6
The Hague	24·6	Naples	31·4
Copenhagen	24·8	Turin	26·8
Christiania	19·9	Venice	28·5
St. Petersburg ...	42·1	Alexandria	42·4
Berlin	29·0	New York	27·7
Hamburg	25·8	Brooklyn	23·6
Dresden	25·1	Philadelphia	20·6
Breslau	31·2	Baltimore	22·2
Munich	34·0	London	22·0
Vienna	27·9	Dublin	27·9
Buda Pesth	37·1	Edinburgh	21·4

Now when reading these various paragraphs many of you might say, "Oh! such a place is very unhealthy; the death-rate is 40 per 1,000, and such another place is 20 per 1,000—just think if I lived in the former place my chance of life would be only half what it would be if I lived in the latter." Undoubtedly the death-rates published weekly, quarterly, and annually by my colleagues in England and Scotland, and by me in Ireland, are *primâ facie* evidence of the relative healthiness or unhealthiness of the population to which they refer, and no doubt a very high death-rate does in nearly every case indicate unhealthiness, and a very low death-rate indicates healthiness of the population to which it relates; but it does not at all follow that a death-rate of, say 40 per 1,000 in one place indicates double the unhealthiness that a death-rate of 20 in another does. To speak in common parlance, the high death-rate really indicates that the population to which it refers has a delicate constitution, and that with a low death-rate a robust constitution. It would be impossible in the time at my disposal on the present occasion, to consider all the details which may tend to modify the significance of comparative death-rates, but I think it will be instructive to deal with some of the more important. It is important, in the first instance, to inquire under what circumstances we may expect to find a low and a high death-rate respectively. If a people, well-fed, well-housed, and well-clothed (in fact well-off), and the district is well-drained, and the climate moderate, we may expect, all other things being equal, to find a low death-rate.

Yet, if the people are employed at unhealthy occupations, and if the population includes an undue proportion of young children, or very old people, the death-rate will be high.

If, on the other hand, a population is badly fed, badly housed, and the district is badly drained, we may expect to find a high

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death-rate, even although the occupations are healthy, and the age constitution of the population duly proportioned.

In estimating the value of death-rates as a test of healthiness, there are some elements to which too much importance appears to have been attached. It is too much the custom to attach exaggerated importance to the proportion of deaths from "zymotic" diseases of an infectious or catching nature as evidence of unhealthiness. I admit that the prevalence of infectious diseases and their fatality is a very important element in estimating the health of a community; nevertheless, if the death-rate from any particular group of diseases was taken as a single test of unhealthiness, I should choose the constitutional, not the zymotic group, as the most reliable. If we take London and Dublin for example, and contrast them as to the relative mortality from particular groups of diseases, we find that the deaths from zymotic diseases, years 1871-80 were 59·3 per 10,000 of population in Dublin, and 48·5 in London, or 18 per cent. greater in Dublin, whereas the death-rate from constitutional diseases in Dublin was 52·6, while in London it was 42·0, or 20 per cent. less. The total death-rate in Dublin during the decade was 283 per 10,000, and in London 235, or ·48 less.

Again, the infantile death-rate is much relied on, but a low infantile death-rate is quite consistent with a high general death-rate, as, for instance, happens to be the case in Dublin, where the general rate of mortality is high, but the infantile mortality is comparatively low. Attempts have been made from time to time to estimate what should be the death-rate of a healthy community, but in my opinion all such efforts have been signal failures; and we are driven to depend upon comparisons of death-rates in various countries with one another, or comparisons of different portions of the same community with the whole or with one another, as the only tests of the healthiness or unhealthiness of such communities. Thus, the average annual death-rate of the population of England and Wales for ten years, 1871—80, was 21·4; while in London it was 22·5. In Scotland it was 21·6 for the same period.

In Ireland for the same decade it was 18·3, and varied from 28·3 in Dublin to 14·1 in the rural districts of Connaught.

Now, do these varying rates truly represent the relative healthiness of the different communities to which they refer? I state, unhesitatingly, that they do not; that in some of these districts the people are less unhealthy, in other cases more unhealthy, than the rates represent them to be.

It is, therefore, of the utmost importance that when we find that *prima facie* a community has a very high death-rate

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or a very low death-rate, or even in some cases an average death-rate, we should minutely investigate all the elements which compose such an exceptional death-rate, then having hunted down the peculiar elements to their habitat in a particular place, class of life, age, sex, or occupation, we shall be in a position to rightly estimate the significance of the high or low death-rate, as the case may be.

It will be necessary, in making such investigations, to consider the death rate in relation to the following conditions :—

1. The locality in which the people live; its climate, soil, &c.; its drainage; the density of the population, and the mode in which they are housed.

2. The wealth or poverty of the people, and their means of obtaining food and clothing.

3. The occupation and social position of the people, and the proportion of each class to the whole and to one another.

4. The age-composition of the population, *i.e.* the population living at each age, and therefore their expectation of life.

5. The diseases of which the people die.

6. The relations of births, marriages, and deaths to one another and to the population.

I shall now endeavour to touch upon each of these questions, and consider how far statistical measures can be fairly applied to their solution.

We have no statistical measure which can be applied as a test of the healthiness of a particular locality as such, although we can state with a considerable degree of accuracy that we are not likely to find a healthy population living in swampy grounds, or in a low-lying locality, which is not sufficiently drained. We also know that the inhabitants of a damp district may have their health materially improved by the drying of the soil by drainage works.

In the matter, however, of climate we can apply statistical tests, and I would take the familiar example of Dublin and London to illustrate this point. In Dublin we have a delicate population as compared with London. If we take the temperature of the air as one of the most important elements of climate, we find that the means for Dublin and London are not very different, Dublin being somewhat more equable in its temperature and therefore more favourable to delicate people.

Table II. shows by weeks a comparison between the death-rate in Dublin for five years ending 1883 with the mean temperature for the same period, and Table III. shows similar conditions for London. If curves be constructed representing the variations of weekly mean temperature in these two districts, compared with

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TABLE II.—Showing a comparison between the mean temperature of the air (from observations taken at the Ordnance Survey Office, Phœnix Park, Dublin,) and the Death Rate in the Dublin Registration district, by weeks, for five years ending December, 1883.

No. of Week.	YEARS. 1879 Mean Temperature.	1879 Death Rate per 1000 of population.	1880 Mean Temperature.	1880 Death Rate per 1000 of population.	1881 Mean Temperature.	1881 Death Rate per 1000 of population.	1882 Mean Temperature.	1882 Death Rate per 1000 of population.	1883 Mean Temperature.	1883 Death Rate per 1000 of population.
1	37°·0	50·6	41°·7	41·0	39°·6	31·7	43°·2	35·8	43°·6	31·8
2	30·6	44·8	35·8	37·8	25·6	34·9	46·0	34·9	40·7	29·3
3	41·0	48·1	29·9	40·2	23·7	45·5	43·0	33·6	43·1	25·4
4	33·8	42·8	41·6	48·6	31·5	47·3	43·9	36·0	41·8	34·8
5	32·7	48·9	45·6	42·5	41·7	46·3	41·2	37·5	37·4	33·9
6	42·9	49·9	39·3	44·9	40·4	41·6	44·0	33·4	42·7	37·8
7	42·2	55·7	44·7	37·7	41·6	38·4	44·4	36·7	41·9	39·0
8	35·9	37·5	43·0	41·8	36·2	38·2	46·0	33·4	44·2	35·5
9	37·8	42·5	46·8	35·9	36·5	35·9	43·9	34·9	45·0	34·6
10	45·6	36·0	42·3	36·4	47·5	33·7	48·5	37·0	37·2	35·4
11	44·0	38·0	44·3	37·0	46·7	30·3	47·0	31·1	36·1	35·2
12	40·2	33·7	41·4	36·5	39·5	34·8	44·1	34·8	33·3	40·3
13	36·7	32·6	46·3	42·8	35·2	30·7	44·4	35·8	39·7	42·8
14	46·1	31·7	44·8	30·6	39·3	30·7	45·5	27·6	44·8	40·2
15	42·1	27·8	43·3	41·3	47·6	28·9	44·3	28·2	45·1	32·7
16	41·2	32·9	49·7	35·7	42·1	32·4	48·7	36·1	45·0	37·0
17	47·4	34·9	43·8	38·2	49·7	30·6	43·5	30·2	42·9	31·1
18	44·5	30·9	45·9	36·4	48·9	27·5	47·0	27·5	45·0	33·9
19	45·2	31·6	47·5	34·9	49·6	29·8	48·4	35·2	43·7	31·5
20	50·4	33·2	54·1	34·0	50·5	25·1	48·6	24·9	51·1	29·4
21	52·1	34·9	51·3	37·8	54·9	24·8	55·3	24·6	55·4	27·4
22	50·4	*51·1	52·8	37·5	58·1	26·4	54·4	25·4	53·4	31·7
23	52·4	40·2	49·2	42·3	47·6	22·0	54·9	24·9	54·0	28·3
24	56·5	40·7	56·7	39·2	55·5	24·1	50·5	19·2	55·2	23·3
25	57·9	39·3	58·7	32·6	56·2	24·4	54·6	23·1	51·9	25·1
26	56·2	43·6	59·2	33·5	56·8	18·7	57·5	20·6	56·5	26·0
27	55·5	26·3	57·8	31·1	60·4	20·6	60·0	20·5	57·9	22·6
28	54·9	22·3	57·0	30·2	62·1	21·0	55·2	16·7	58·1	20·5
29	56°·6	29·1	57°·6	30·1	59°·5	24·3	58°·1	21·8	54°·6	22·6
30	57·6	24·8	59·0	28·1	56·0	17·5	57·3	20·8	54·6	21·7
31	57·5	22·8	59·0	35·2	59·8	19·4	59·1	22·8	57·6	17·1
32	54·0	23·8	61·7	35·2	57·0	22·2	60·0	23·4	57·1	20·8
33	58·3	27·6	58·3	37·7	54·8	15·5	58·9	20·0	56·7	24·8
34	57·8	22·8	59·1	37·7	52·7	21·2	54·8	23·7	57·5	21·1
35	54·8	21·3	63·1	35·4	51·4	16·6	56·5	27·2	57·8	23·3
36	55·0	26·1	56·8	34·5	54·8	19·2	53·2	27·5	53·3	24·4
37	54·6	30·9	53·9	39·2	51·1	21·9	49·8	25·7	51·7	27·4
38	52·4	24·3	55·8	38·3	53·8	22·8	51·9	26·0	55·4	24·4
39	49·5	23·5	54·1	35·9	55·1	17·8	49·4	23·6	54·7	23·6
40	50·1	25·6	46·6	33·2	47·9	18·7	54·6	19·9	46·9	23·3
41	48·1	28·8	47·8	32·9	48·1	18·2	50·2	24·3	50·6	25·7
42	46·6	32·6	40·3	32·6	46·1	21·9	47·2	22·4	46·2	23·2
43	49·7	32·2	39·7	34·7	45·7	22·9	43·7	22·4	46·9	24·8
44	46·4	30·6	41·3	34·2	44·6	30·4	47·4	20·3	49·4	28·1
45	43·9	30·1	47·2	39·5	52·1	21·3	41·8	27·6	41·4	25·7
46	41·4	30·1	35·9	33·2	51·3	21·2	39·2	26·0	39·1	25·1
47	45·7	38·0	43·5	37·7	46·0	29·1	43·5	29·1	40·9	32·9
48	38·8	31·2	46·0	29·7	45·0	24·5	38·5	25·5	46·5	25·6
49	29·0	37·0	48·8	27·1	38·6	28·8	33·1	24·8	37·4	33·2
50	32·0	44·3	41·5	25·8	33·7	33·9	24·5	33·4	43·3	32·0
51	36·3	48·9	36·5	26·9	37·0	34·8	41·5	37·9	40·9	36·0
52	42·9	44·8	34·2	35·7	46·2	38·9	45·3	32·0	42·1	27·4
Year	46·5	35·7	48·1	35·9	47·2	27·0	48·2	27·8	47·5	29·1
53	45·8	43·3								

* At this date burial returns were first received under the Public Health Act (Ireland) 1878, and there was consequently a sudden decrease in the number of unregistered deaths.

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TABLE III.—Showing a comparison between the mean temperature of the air (from observations taken at the Royal Observatory at Greenwich,) and the Death Rate in the London Registration district, by weeks for five years ending December, 1883.

No. of Week.	YEARS. 1879 Mean Temperature.	1879 Death Rate per 1000 of population.	1880 Mean Temperature.	1880 Death Rate per 1000 of population.	1881 Mean Temperature.	1881 Death Rate per 1000 of population.	1882 Mean Temperature.	1882 Death Rate per 1000 of population.	1883 Mean Temperature.	1883 Death Rate per 1000 of population.
1	41°·4	27·4	34°·8	25·0	38°·4	20·6	43°·9	24·9	46°·2	20·5
2	28·2	27·0	33·1	24·6	28·0	21·9	43·9	23·3	38·3	20·7
3	35·4	28·1	29·7	27·1	23·4	27·5	36·2	22·8	42·9	21·9
4	29·2	26·1	29·2	31·3	32·5	28·8	36·8	26·4	38·9	20·4
5	31·6	26·2	38·8	48·1	42·8	26·2	36·7	27·1	40·3	21·7
6	39·8	26·5	40·6	35·5	38·8	22·2	38·1	35·3	42·7	21·5
7	43·8	23·7	46·7	28·7	38·0	21·3	45·5	29·3	42·9	20·1
8	35·8	23·7	40·5	23·7	34·4	20·8	44·3	26·0	42·8	20·5
9	34·8	25·5	48·5	22·9	37·1	22·2	44·3	24·0	43·0	21·0
10	42·1	29·2	46·3	20·5	49·4	21·7	48·1	24·0	33·8	21·7
11	42·1	28·7	41·3	20·9	44·8	19·9	47·6	22·7	34·7	24·5
12	43·6	30·0	42·4	21·4	39·5	20·7	44·6	24·5	35·1	24·9
13	35·5	29·9	44·9	24·7	39·1	21·1	46·6	22·2	38·6	28·3
14	45·4	28·2	44·8	21·8	40·5	20·9	47·6	21·4	48·8	25·6
15	43·0	25·7	46·4	21·6	50·8	22·3	47·6	23·1	44·0	23·8
16	40·1	25·3	51·9	20·2	43·5	21·8	49·9	21·1	48·0	23·2
17	44·7	25·5	44·8	19·8	49·9	21·1	46·5	20·4	45·2	21·6
18	43·9	23·8	47·1	20·2	51·0	20·1	52·0	20·0	46·2	19·8
19	43·1	22·8	52·1	19·8	50·7	19·4	53·7	19·2	46·5	21·8
20	47·9	22·1	53·9	18·5	53·1	20·3	50·7	19·0	57·5	20·2
21	53·7	21·6	58·4	19·0	59·5	19·8	57·6	19·2	58·2	20·0
22	51·7	20·6	51·7	18·6	62·9	20·5	58·5	17·5	58·1	18·5
23	54·7	19·5	53·9	18·4	51·2	18·3	56·2	18·3	58·0	18·5
24	57·3	19·5	58·9	17·7	60·4	19·1	53·1	17·9	58·1	16·9
25	58·4	19·0	59·9	18·1	60·6	19·1	57·3	18·6	56·2	17·6
26	56·5	18·3	62·3	18·5	61·9	19·6	59·9	17·5	63·2	18·9
27	56·5	17·4	59·0	18·9	65·1	21·6	59·9	17·3	64·3	20·1
28	56·0	17·0	63·1	20·5	70·1	24·7	59·8	18·1	61·4	22·9

No. of Week.	YEARS. 1879 Mean Temperature.	1879 Death Rate per 1000 of population.	1880 Mean Temperature.	1880 Death Rate per 1000 of population.	1881 Mean Temperature.	1881 Death Rate per 1000 of population.	1882 Mean Temperature.	1882 Death Rate per 1000 of population.	1883 Mean Temperature.	1883 Death Rate per 1000 of population.
29	58°·4	17·2	63°·7	21·1	66°·4	26·5	61°·0	17·7	56°·0	23·5
30	57·4	17·4	62·2	24·9	60·5	27·2	60·2	18·8	57·4	21·2
31	64·0	19·4	60·2	24·2	63·8	23·4	62·5	18·3	60·6	19·3
32	59·5	17·6	63·8	23·8	59·0	21·5	61·0	19·2	59·4	17·3
33	63·1	19·4	63·8	21·3	58·1	20·1	60·6	20·5	62·3	19·0
34	58·7	19·1	62·7	21·2	58·0	18·3	57·0	18·8	64·0	17·9
35	58·4	20·0	67·3	20·8	54·5	16·2	58·1	19·7	62·5	17·0
36	56·8	20·1	62·8	19·8	55·4	16·7	57·3	17·7	54·7	16·6
37	57·6	18·2	55·7	20·5	55·0	15·7	51·3	17·0	57·8	16·6
38	57·6	19·7	56·4	20·5	58·2	17·4	53·0	19·4	58·4	17·0
39	53·1	17·2	56·6	19·3	53·2	16·6	53·8	19·4	57·1	16·6
40	54·5	19·0	50·5	19·9	47·1	18·6	55·4	19·1	47·7	16·5
41	51·5	19·7	48·0	20·0	49·0	19·9	54·1	20·9	51·4	19·0
42	45·0	21·6	42·9	21·6	43·7	21·6	49·4	19·4	51·3	18·6
43	49·4	22·5	42·0	21·7	43·5	21·6	45·9	19·6	50·9	19·1
44	46·6	21·6	39·3	21·6	43·1	22·4	50·0	20·1	49·0	19·0
45	43·2	22·0	46·3	23·3	51·6	22·3	46·5	20·0	44·1	20·5
46	40·3	23·2	40·8	21·2	49·0	19·5	36·8	21·1	39·4	22·2
47	37·4	25·4	42·4	21·7	49·5	21·8	44·7	22·5	43·9	22·0
48	33·2	26·0	44·1	20·6	44·6	19·9	37·4	21·5	46·3	21·8
49	27·1	27·2	47·7	19·9	40·4	20·7	36·5	22·4	37·8	21·5
50	31·1	30·7	43·3	19·6	38·8	22·3	34·1	26·8	44·0	22·7
51	32·7	31·8	40·6	17·7	36·8	22·5	42·1	27·1	40·9	21·2
52	31·4	27·1	40·6	23·5	41·4	28·3	48·8	23·0	40·0	19·8
Year	46·2	23·3	49·4	22·2	48·8	21·2	49·7	21·4	49·4	20·4
53	45·7	31·5								

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the weekly deaths, it will be seen (as an analysis of the tables proves) that while in each district sudden falls of temperature, or considerable cold, lasting for an extended period, are accompanied by material increase of death-rate, yet the addition to the death-rate in Dublin under such circumstances is much greater in proportion to the cause than it is in London, thus showing that the more delicate, in other words, the less healthy, population of Dublin is more easily injured by cold than the more robust population of London. *Why* this is so is a separate question but the fact, I think, will be found proved, whenever tested, that a population whose death-rate is extremely sensitive to alterations of temperature, is an unhealthy population and has generally a high death-rate at all times.

It has long been known that a very general relation exists between the density of a population and its death-rate; in other words, that where people are packed closely together we expect to find a high death-rate. This at first sight appears to be a mere truism, but I am glad to say that the old sanitary, or *un*sanitary maxim, "that a dense population has a high death-rate," is becoming less true every day, it has been proved by the operations of artizans' dwellings companies and others who have undertaken to provide dwellings for the working classes, that with reasonable precautions very dense populations can enjoy very good health and have very low death-rates. Unfortunately, however, this old maxim has a considerable degree of truth still left, and a glance at Table IV. shows that there *is* a correspondence between high death-rates and density of population, which may be best exemplified by contrasting Liverpool and Manchester with Leeds and Sheffield; but many notable exceptions will be observed in the same Table. The very natural inference has been drawn that the principal zymotic, or *infectious* diseases (as they are popularly called), contribute largely to this high death-rate in dense populations; a reference to Table IV. shows, however, that this influence cannot be very potent, and, indeed, Liverpool is the only instance in the Table where it is well marked. Some will consider that I should have taken an average over several years and not confined myself to constructing a Table for one year; but my experience has led me to believe that the variations in density of populations in towns are so great and rapid that it is difficult to deal fairly with the question at any considerable distance from a Census period. I have, therefore, confined my comparisons to the year 1881, where I am certain of the facts. It would appear that more can be done by rearranging and redistributing the dense populations within existing areas than by making futile attempts to diminish density. Working people *must* live near their work,

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TABLE IV.—*Showing the number of persons to an acre, the death-rate per* 1,000 *living, from all causes, and from principal zymotic diseases in* 13 *towns of the United Kingdom in the year* 1881.

Cities and Towns.	Persons per acre.	Death rate per 1,000, all causes.	Death rate per 1,000. Principal Zymotic diseases.
London	50·8	21·2	3·6
Liverpool	106·3	26·7	4·5
Birmingham	47·9	20·0	2·7
Manchester	79·5	25·5	2·3
Leeds	14·4	21·6	2·9
Sheffield	14·5	21·1	2·7
Bristol	46·6	19·6	2·3
Bradford	25·5	19·7	2·0
Dublin	14·1	27·0	2·5
Belfast	34·7	23·6	2·4
Cork	35·4	26·2	4·0
Edinburgh	54·8	20·1	2·7
Glasgow	84·9	25·2	3·2

or at all events not very far from it, and the experience of artizans' dwellings companies has proved that density of population and good health are quite compatible with one another. We have not the means (except in Ireland) of measuring house accommodation by statistical standards, and it is much to be regretted that the system adopted in taking the Irish Census, of ascertaining exactly the nature of the house accommodation of the people has not been adopted in other countries. It would be out of place to go into details on this question now, and I must refer to the reports of the Irish Census for information upon the subject.*

The next question to discuss is the wealth or poverty of the people, and consequently their ability to obtain the necessaries of life, in the way of food, clothing, and house accommodation. I have made many attempts to establish statistical tests of these conditions, but the absence of reliable statistics of wages, the variations in the method of relieving the poor and needy, through the Poor Law or otherwise, have quite baffled my efforts. I believe statistics on these subjects would be difficult to compile, though not impossible; and, if compiled, I believe it would be difficult to utilize them.

* Reports of the Census Commissioners for Ireland for 1841—51—61—71 and 81.

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Closely connected with the question of the poverty or wealth of a community, as a test of the significance of its death-rate, is that of the social composition of the community.

It is a matter of the utmost importance, when applying the death-rate as a test of health, that the relative numbers of the population belonging to each social class should be known. We are all, unfortunately, too well aware of the fact that the death-rate among the "weekly-wage-earning" class, especially among children, is higher than in the classes above it. Now, although the Census returns take note of the occupations of the people, they do not take note of the numbers of persons dependent for subsistence on each kind of occupation; thus, the Census reports tell us how many blacksmiths there are in the United Kingdom, but do not tell us how many blacksmiths' wives and children there are, and therefore how many persons are supported and dependent upon the trade of the blacksmith.

Some years ago the Dublin Sanitary Association—which has had so much to do with the organizing of this Congress—considered this question, and determined when the next census period approached, that they would ask the government to include returns of the social condition of the people of Dublin in the census returns for 1881. The government at once acceded to the request, and Table V., extracted from the annual summary of the weekly returns issued by my department, shows for the Dublin registration district, the number of the population belonging to each class, as extracted from the census returns of 1881, and their death-rates for the year 1883.

The variations in the death-rate between the classes and the sub-classes are remarkable. For example, in the "professional class" the death-rate is but 19·8 per 1,000, while in the "general service class and workhouse inmates" it is 36·8, or nearly double. Among domestic servants it is but 9·1, while among labourers it is 34·4, although both are drawn from the same stratum of society. These returns, and the use to which I have applied them, exist only for Dublin. In Dublin this method of dealing with mortality statistics is only in an experimental stage, and therefore must have many imperfections.

As similar statistics do not exist for any other locality, comparisons cannot be instituted between Dublin and other places, but nevertheless some lessons may be learned from studying the Dublin figures which may serve as useful illustrations of the point under discussion.

Table VI. shows, by age-periods, the composition of the various social classes, and Table VII. gives a summary, by percentages, of the more important elements in Table VI.

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TABLE V.—Showing, in Five General Classes and Eighteen Groups, the Occupations or Social Position of the Persons whose Deaths were registered in the Dublin Registration District during the 52 Weeks ending Saturday, 29th Dec., 1883; the Annual Death-rate represented by the Deaths registered; the Number of Deaths at each of Six Periods of Life, and the Number from each of the Principal Causes of Death.

Class.	Occupation or Social Position. [The 20,967 persons returned under the head "Unspecified" in Table 89 of the General Report on the Census have been distributed *pro rata* among the several groups to which they most probably belonged.]	Population in each Class and Group in 1881.	Registration of Deaths, Year ending Saturday, 29th December, 1883. Annual Death Rate per 1000 of the Population in 1881.	Total Number of Deaths.	Ages. Under 5 Years.	5 and under 20.	20 and under 40.	40 and under 60.	60 and under 80.	80 and upwards.	Causes of Death. Principal Zymotic Diseases. Small Pox.	Measles.	Scarlatina.	Typhus.	Whooping Cough.	Diphtheria.	Simple contd. and Ill-defined Fever.	Enteric Fever.	Diarrhœa, Dysentery.	Total.	Phthisis.	Convulsions.	Diseases of the Respiratory System.	Violence (Accidental, Homicidal, and Suicidal).	Other Causes.
	ALL PERSONS	346693	29·3	10161	3018	911	1694	2048	2065	425	...	27	179	141	333	14	37	132	237	1100	1330	823	2131	238	4539
	Families of the—																								
I.	Professional and Independent Class	30129	19·6	598	49	33	89	113	212	102	...	2	5	3	5	4	2	8	7	26	43	6	103	8	402
II.	Middle Class	56761	24·2	1375	340	135	271	247	300	82	...	4	19	8	43	1	3	31	32	41	169	68	281	36	680
III.	Artizan Class and Petty Shopkeepers	106142	23·8	2529	905	305	397	476	391	55	...	11	68	49	114	5	8	38	51	344	331	244	552	52	1006
IV.	General Service Class	147625	36·8	3877	1496	394	666	732	500	89	...	10	87	76	164	4	18	53	122	534	487	424	839	133	1460
V.	Inmates of Workhouses	6036		1782	228	44	271	480	662	97	...	...	...	5	7	...	6	2	25	45	300	81	356	9	991
I.	Professional and Independent Class.																								
	1. Clerical, Medical, Legal, and other Professions; Naval and Military Officers, and Heads of Public Departments	8728	28·4	248	30	12	45	53	79	29	...	2	1	2	2	2	...	4	4	17	25	4	37	5	160
	2. Merchants & Manufacturers, Higher Class	2371	16·4	39	3	6	5	7	11	7	...	...	3	...	...	...	...	1	...	4	4	...	6	...	25
	3. Persons of Rank and Property, not otherwise described	19030	16·3	311	16	15	39	53	122	66	...	...	1	1	3	2	2	3	3	15	14	2	60	3	217
II.	Middle Class.																								
	4. Genl. Officials—Civil Service, Banking, &c.	5138	15·0	77	17	7	17	12	18	6	...	...	1	...	6	...	1	..	4	12	10	1	16	3	35
	5. Traders (except Petty Shopkeepers), Business Managers, &c.	18207	26·0	473	130	50	83	98	93	24	...	3	9	4	13	...	...	11	10	50	45	29	89	16	244
	6. Clerks and Commercial Assistants	22587	18·7	422	140	47	110	60	57	8	...	1	6	3	20	1	2	15	8	56	74	26	78	4	184
	7. Miscellaneous, including all Householders in Second Class Localities, not included in above	10629	37·2	403	53	31	61	82	132	44	...	...	3	1	4	...	...	5	10	23	40	12	98	13	217
III.	Artizan Class and Petty Shopkeepers.																								
	8. Working Engineers, Engravers, Printers, Watchmakers, and Jewellers	7863	27·6	217	103	26	33	32	21	2	...	..	8	2	12	1	1	8	4	36	28	25	42	11	75
	9. Building and Furnishing Trades	29900	26·9	805	354	100	116	127	101	7	...	5	28	14	44	2	2	11	18	124	105	112	174	14	276
	10. Clothing Trades	30299	16·2	492	157	61	83	108	72	11	...	2	12	6	16	1	1	12	10	60	77	40	112	11	192
	11. Food Supply Trades	7082	24·9	176	61	21	30	32	23	9	...	2	6	10	7	...	...	2	1	28	11	15	41	3	78
	12. Other Trades and Callings	23596	26·7	629	166	75	105	128	134	21	...	1	12	13	28	1	2	4	13	74	87	37	123	13	295
	13. Petty Shopkeepers	7462	28·1	210	64	22	30	49	40	5	...	1	2	4	7	...	2	1	5	22	23	15	60	...	90
IV.	General Service Class.																								
	14. Army, Police, Postal, Prison Services, &c.	13335	28·5	380	126	24	93	75	52	10	...	2	6	2	6	1	1	15	13	46	58	27	72	15	162
	15. Domestic Servants	43868	9·1	399	51	30	115	98	85	20	...	1	2	8	3	1	4	2	17	38	73	18	78	10	182
	16. Coach and Car Drivers, Vanmen, &c.	9486	33·4	317	132	32	60	51	35	7	...	1	9	5	15	1	...	4	12	47	35	31	74	13	117
	17. Hawkers, Porters, Labourers, &c.	80936	34·4	2781	1187	308	398	508	328	[illegible]	...	6	70	61	140	1	13	32	80	403	321	348	615	95	999
V.	Inmates of Workhouses.																								
	18. Workhouse Inmates	6036	—	1782	228	44	271	480	662		...	...	...	5	7	...	6	2	25	45	300	81	356	9	991

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TABLE VI—Showing by AGES, in FIVE GENERAL CLASSES and EIGHTEEN GROUPS, the OCCUPATIONS or SOCIAL POSITION of the INHABITANTS of the Dublin Registration District.

CLASS.	OCCUPATION OR SOCIAL POSITION. [The 25,967 persons returned under the head "Unspecified" in Table 89 of the General Report on the Census have been distributed *pro rata* among the several groups to which they most probably belonged.]	Population in each Class and Group in 1881.	AGES. Under 5 years.	5 and under 15.	15 and under 20.	20 and under 40.	40 and under 60.	60 and under 80.	80 and upwards.
	ALL PERSONS	346693	37441	63701	34950	120857	64218	23874	1652
	CLASSES.								
	Families of the—								
I.	PROFESSIONAL AND INDEPENDENT CLASS	30129	2247	4710	2428	9328	6654	4334	428
II.	MIDDLE CLASS	56761	6188	10858	7249	20843	8895	2604	124
III.	ARTIZAN CLASS AND PETTY SHOPKEEPERS	106142	12895	21424	10527	34989	13652	6289	366
IV.	GENERAL SERVICE CLASS	147625	16111	26709	14746	55697	29017	10647	734
V.	INMATES OF WORKHOUSES	6036							
I.	PROFESSIONAL AND INDEPENDENT CLASS.								
	1. Clerical, Medical, and other Professions; Naval and Military Officers; and Heads of Public Departments	8728	938	1523	622	2763	1985	839	58
	2. Merchants and Manufacturers, Higher Class	2371	348	591	177	587	475	181	12
	3. Persons of Rank and Property, not otherwise described...	19030	961	2596	1629	5978	4194	3314	358
II.	MIDDLE CLASS.								
	4. General Body of Officials—Civil Service, Banking, &c.	5138	651	1060	468	1769	913	268	9
	5. Traders (except Petty Shopkeepers), Business Managers, &c.	18207	2691	4447	1365	5063	3564	1035	42
	6. Clerks and Commercial Assistants	22587	2247	3504	3661	9731	2749	669	26
	7. Miscellaneous—including all Householders in Second Class Localities, not included in above	10629	599	1847	1755	4280	1669	632	47
III.	ARTIZAN CLASS AND PETTY SHOPKEEPERS.								
	8. Working Engineers, Engravers, Printers, Watchmakers, and Jewellers	7863	1289	1822	789	2747	986	229	1
	9. Building and Furnishing Trades	29900	4417	6694	2332	9511	5165	1675	106
	10. Clothing Trades	30299	2399	4658	3791	11144	6115	2064	128
	11. Food Supply Trades	7082	1079	1623	612	2319	1182	253	14
	12. Other Trades and Callings ranking with Trades ...	23536	2929	5057	2383	7229	4352	1495	91
	13. Petty Shopkeepers	7462	782	1570	620	2039	1852	573	26
IV.	GENERAL SERVICE CLASS.								
	14. Army, Police, Postal Delivery, and Prison Services, &c.	13335	1515	1809	752	6911	1853	476	19
	15. Domestic Servants	43868	1935	4282	6317	18913	8873	3341	207
	16 Coach and Car Drivers, Vanmen, &c.	9486	1581	2209	528	3229	1641	295	3
	17. Hawkers, Porters, Labourers, &c....	80936	10719	17767	6912	25274	15081	4837	346
V.	INMATES OF WORKHOUSES.								
	18 Workhouse Inmates	6036	361	642	237	1370	1569	1698	159

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TABLE VII.—*Showing proportion per cent. of persons living in the Dublin Registration District at each age period who belonged to each of the classes of "occupations" and social position in* 1881:

Classes.	All ages.	Under 5 years.	5 and under 15.	15 and under 20.	20 and under 40.	40 and under 60.	60 and under 80.	80 and upwards.
All Classes.	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0
I. Professional and Independent Class ...	8·7	6·0	7·4	6·9	7·7	10·4	18·4	25·9
II. Middle Class	16·4	16·5	17·1	20·8	17·2	13·8	10·8	7·5
III. Artizan Class and Petty Shopkeepers.	30·6	34·5	33·6	30·1	29·0	30·6	26·3	22·2
IV. General Service Class ..... V. Inmates of Workhouses	44·3	43·0	41·9	42·2	46·1	45·2	44·6	44·4

Time will not permit an analysis of the interesting information contained in these two tables; but I would point out that, in the larger groups which are dealt with in the summary (VII.), the proportions living at different ages in each class of the population of Dublin do not differ as widely from one another as some might contemplate. I shall have again to refer to this point, when dealing with the relations of age-composition of populations to death-rate, to illustrate which, in connection with social class, Table VIII. has been constructed, where the death-rates of children under five years of age are set out by social class. It may be observed, in passing, that the death-rate of children among the professional group is 21·8 per 1000 living, while in the general service class, and workhouse inmates combined, it is 107 per 1,000 living, or about five times the proportion.

The next point to be considered in the application of statistical measures of health is the age-composition of the community to which the measure is to be applied. The number of persons living at different ages differs materially in different communities. In Table IX. the proportion of persons per 1,000 living at each age is compared for England and Ireland. From this it would appear that the number of very young people in England is relatively much greater than in Ireland, the number of children under five

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TABLE VIII.—*Shewing the death rates in* 1883 *per* 1,000 *living, under* 5 *years* (*according to the Census of* 1881), *for each group of occupations in the Dublin Registration District.*

Occupation or Social Position.	Rate per 1,000 living under 5.
ALL CHILDREN UNDER 5 YEARS	80·6
CLASSES.	
Deaths of children under 5 years in the families of the—	
I. PROFESSIONAL AND INDEPENDENT CLASS	21·8
II. MIDDLE CLASS	54·9
III. ARTIZAN CLASS AND PETTY SHOPKEEPERS	70·2
IV. GENERAL SERVICE CLASS } V. INMATES OF WORKHOUSES }	107·0
I. PROFESSIONAL AND INDEPENDENT CLASS—	
1. Clerical, Medical, Legal, and other professions, Naval and Military Officers; and Heads of Public Departments	32·0
2. Merchants and Manufacturers, Higher Class	8·6
3. Persons of rank and property, not otherwise described	16·6
II. MIDDLE CLASS—	
4. General body of Officials—Civil Service, Banking, &c.	26·1
5. Traders (except Petty Shopkeepers), Business Managers, &c.	48·3
6. Clerks and Commercial Assistants	62·3
7. Miscellaneous—including all Householders in second-class localities not included in above	88·5
III. ARTIZAN CLASS AND PETTY SHOPKEEPERS—	
8. Working Engineers, Engravers, Printers, Watchmakers, and Jewellers.	79·9
9. Building and Furnishing Trades.	80·1
10. Clothing Trades.	65·4
11. Food Supply Trades	56·5
12. Other trades and callings ranking with trades	56·7
13. Petty Shopkeepers	81·8
IV. GENERAL SERVICE CLASS—	
14. Army, Police, Postal Delivery, and Prison Services, &c.	83·2
15. Domestic Servants	26·4
16. Coach and Car Drivers, Vanmen, &c.	83·5
17. Hawkers, Porters, Labourers, &c.	110·7
V. INMATES OF WORKHOUSES	—

years being 135·5 per 1,000 inhabitants in England, as compared with 111·3 in Ireland. In the case of infants under one year it is more remarkable, there being 29 "babies" in England to 20·3 in Ireland, a fact which is very different from commonly received opinions. At the other extreme of life we find that there are more old people in proportion in Ireland, where those above 60 number 106·2 per 1,000 of the population, than there are in England, where they number but 73·8 per 1000.

Now as very young children die at a greater rate than older children, or persons in middle life, we might expect the death-rate of England to be much higher than that of Ireland,

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TABLE IX.—*Showing the age-compositions of the populations of England and Ireland in* 1881 :—

Age. Periods.	England.		Ireland.	
	Population. 1881.	Number in every 1,000 of the Population	Population. 1881.	Number in every 1000 of the Population
Under 1 year	753,113	29·0	104,965	20·3
1 and under 2....	684,412	26·3	102,093	19·7
2 ,, 3....	704,409	27·1	118,864	23·0
3 ,, 4....	691,695	26·6	122,507	23·7
4 ,, 5....	687,235	26·5	127,554	24·6
Total under 5....	3,520,864	135·5	575,983	111·3
5 and under 10....	3,147,396	121·2	621,637	120·1
10 ,, 15....	2,800,331	107·8	616,370	119·1
15 ,, 20....	2,547,232	98·1	558,956	108·0
20 ,, 40....	7,663,086	295·1	1,362,325	263·2
40 ,, 60....	4,379,264	168·5	889,726	172·1
60 and upwards	1,916,266	73·8	549,839	106·2
Total	25,974,439	1,000·0	5,174,836	1,000·0

TABLE X.—*Showing the age-compositions of the populations of London and Dublin in* 1881 :—

Age Periods.	London.		Dublin. (Dublin City, Rathmines, Donnybrook, Blackrock, & Kingstown).	
	Population 1881	Number in every 1000 of the Population.	Population 1881.	Number in every 1000 of the Population.
Under 1 year	111,593	29·2	7,714	23·7
Total under 5	497,044	130·2	34,996	107·6
5 and ,, 10	419,740	110·0	30,609	94·1
10 ,, ,, 15	366,111	95·9	28,226	86·8
15 ,, ,, 20	368,628	96·6	32,482	99·9
20 ,, ,, 40	1,277,634	334·8	113,700	349·6
40 ,, ,, 60	647,551	169·7	60,756	186·8
60 and upwards.	239,775	62·8	24,456	75·2
Total....	3,816,483	1,000·0	325,225	1,000·0

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but it is only a *little* higher. And why is this? Because the old people, whose lives are also precarious, are more numerous in Ireland than in England, and thus tend to diminish the excess of mortality of England over Ireland. Table X. makes a similar comparison between the age-periods of London and Dublin with somewhat similar results as regards age-composition of the population, but the results of the investigations of the death-rate will prove very different.

I have just referred to the fact that death-rate varies much at different periods of life, being high at the extremes, where the feebleness of infancy and of old age renders the very young or very old liable to death from causes which would scarcely affect those in the robust health of adult or middle life. In Table XI. we have set out by age-periods the death-rates of the populations of England and Ireland.

TABLE XI.—*Showing the population of England and Ireland by age-periods according to the Census of* 1881, *and the death-rate at each age period for the same year:*

Age Periods.	ENGLAND.			IRELAND.		
	Population 1881.	Deaths.		Population 1881.	Deaths.	
		Number.	Rate per 1000 living.		Number.	Rate per 1000 living.
All ages	25,974,439	491,935	18·9	5,174,836	90,035	17·4
Under 1	753,113	114,976	152·7	104.965	11,481	109·4
1 & under 2	684,412	35,033	51·2	102,093	3,366	33·0
2 „ 3	704,409	15,682	22·3	118,864	2,142	18·0
3 „ 4	691,695	10,577	15·3	122,507	1,436	11·7
4 „ 5	687,235	7,914	11·5	127,554	1,065	8·3
Total under 5	3,520,864	184,182	52·3	575,983	19,490	33·8
5 & under 10	3,147,396	18,084	5·8	621.637	3,072	4·9
10 „ 15	2,800,331	9,102	3·3	616,370	2,275	3·7
15 „ 20	2,547,232	11,806	4·7	558,956	2,990	5·3
20 „ 25	2,328,226	14,103	6·1	477,296	3,480	7·3
25 „ 35	3,793,461	30,681	8·0	633,782	5,526	8·7
35 „ 45	2,940,753	35,222	11·9	558,776	5,770	10·3
45 „ 55	2,173,446	37,067	16·2	443,055	6,669	15·1
55 „ 65	1,534,086	47,337	30·8	364,120	10,836	29·8
65 „ 75	852,424	53,607	61·1	213,571	13,539	63·4
75 „ 85	298,072	40,214	128·9	93,675	12,324	131·6
85 and upwards	38,148	10,530	243·3	17,615	4,064	230·7

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It will be observed that in both countries the highest death-rate is among children, the deaths under one year being 109·4 per 1,000 living at that age in Ireland, and 152·7 per 1,000 in England, as compared with general death-rates of 17·4 and 18·9 respectively. The table shows that the death-rate steadily decreases as age increases, until the age-period of from ten to fifteen years is reached, when the rate reaches the minimum both in Ireland and England, being 3·7 in Ireland, and 3·3 in England. After this period the troubles and risks of life are entered upon, and the death-rate steadily rises until the age of sixty-five is passed, when the rate increases by enormous strides.

It is remarkable, on comparing Ireland with England, that up to the age of ten the death-rate of English children is higher than that of Irish, and after that period the Irish death-rate is almost uniformly in excess of the English. It looks as if the real struggle for existence were harder in Ireland than on the other side of the Channel. This, however, is not likely to be the case, and the difference is probably owing to the larger emigration from Ireland. It is well known that in all countries of Europe it is the most able-bodied, strong-minded, and enterprising who emigrate, to seek wider fields for their energies than are afforded by the overcrowded countries of the Old World. This principle affects Ireland more than England, just in proportion as the number of emigrants is greater; the able-bodied and energetic go, the delicate and less active remaining. The higher death-rate among children in England as compared with Ireland cannot, however, be thus explained. Is it that Irish mothers are more careful of their little ones than English mothers? I trust that, with all our differences, there is none between Englishwomen and Irishwomen in their love and care of their little ones. Indeed, it would ill become me to enter upon such a comparison, as my mother was an Irishwoman, and the mother of my children is an Englishwoman. The explanation is simple, though it may surprise some: it is the difficulty of bringing up healthy children in large towns, and the mothers leaving them, to work in mills or at other occupations.

In England there are many more large towns than in Ireland. In England of the 25,974,439 people (according to the census of 1881) 14,626,131 live in towns having a population of 10,000 or upwards, and 11,348,308 live in country districts and small towns.

In Ireland of the 5,174,836 only 845,839 live in towns with populations over 10,000, while the balance 4,328,997 live in country districts and villages. In other words 56·3 per cent. of the English people belong to town populations, and but 16·3 per cent. of the Irish people live in considerable towns.

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The following statement, showing for 1881 the proportion of deaths under one year to every thousand births, demonstrates the danger to infant life in large towns; and shows that this danger is, as a rule, greater in manufacturing than in other towns:—

London	154	Glasgow	151
Birmingham	167	Dublin	170
Manchester	176	Belfast	147
Edinburgh	135		

Again, with a view of testing the question further, I take two registration counties of England, namely, Lancashire and Somersetshire, the former of which contains a large population resident in towns and the latter a small proportion of its population so residing, and I find that in the former case the infant death-rate was 167, while in the latter it was only 116.

TABLE XII.—*Showing by age-periods the death-rate per* 1,000 *living at each period in London and in Dublin in* 1881.

Age-Periods.	Deaths per 1000 living in LONDON.	Deaths per 1000 living in DUBLIN.
Under 1 year.....	175·4	213·2
1 and under 5 years	35·7	38·9
Total under 5 years	67·0	81·2
5 and under 20 years	5·2	8·5
Total under 20 years.....	23·8	28·6
20 and under 40 years	8·9	14·7
40 „ 60 „	20·7	32·2
60 „ 80 „	62·0	90·0
80 years and upwards	204·3	243·1
Total	21·2	27·0

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The difference in mortality, not only among infants, but at other ages, in some towns, as compared with others, cannot be altogether attributed to the peculiarities of a manufacturing population, for if we compare London and Dublin, neither of which can be considered as inhabited by populations *especially* engaged in manufacturing industries, we find, according to Table XII., that the mortality of Dublin at all ages, especially among infants, far exceeds that of London.

Now, why is this? I am unable, from want of information, to give a positive answer to this question; but I believe that a great deal of the difference depends on the social condition of the communities, and the more prosperous condition generally of the lower social strata of society in London than in Dublin.

This is, no doubt, a bold assertion, especially when we know how great are the miseries of outcast London. If, however, we look again to the social condition table for Dublin (Table VI.) and to the mortality tables (Table V.) by social classes, we see that the vast bulk of the infantile mortality takes place among the "general service" and "pauper" class, which (Tables V. and VI.) constitute nearly half (44·3 per cent.) of the population of the Dublin registration district.

It is a melancholy fact, but nevertheless it is a fact, that the struggle for maintenance among the members of a large family (and indeed not unfrequently in a small family), in the lower strata of society, is so intense, that it results in the injury of all the members, and the death of many. This is really one of the first questions of the day, and one which, unfortunately, has not been sufficiently attended to by many social reformers, but with which I cannot deal here.

In connection with the question of the effect of age-composition of a community in relation to its death-rate, I would draw special attention to some remarks on the subject in the summary of births and deaths of the Registrar General for England, for the year 1883. In this summary a very ingeniously constructed table is introduced, by which this effect of age-composition on death-rate of population is shown, and death-rates corrected according to standards derived from the age and sex composition of the population of England and Wales, are given for all the large towns of England and Wales and then compared with the recorded death-rates. In some cases the differences between the two rates are very considerable. I have had some experimental calculations made on Irish death-rates, based on the principles suggested by the Registrar General of England, and there can be no doubt that such investigations will tend to throw further light on the statistical measures of the health of communities.

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TABLE XIII.—*Average death-rates per* 10,000 *for certain diseases and groups of diseases in the Dublin Registration District and the London Registration District for the decade* 1871-80.

Name of Disease.	Death-rate, per 10,000 living.	
	Dublin.	London.
Zymotic Diseases:		
Small-pox	9·2	4·4
Measles	5·4	5·1
Scarlatina	9·6	6·0
Diphtheria	1·1	1·2
Whooping Cough	5·5	8·2
Fever	10·0	3·8
Dysentery	0·5	0·2
Diarrhœa	7·6	9·4
Other Zymotic Diseases	10·4	10·2
Total	59·3	48·5
Constitutional Diseases:		
Phthisis or Pulmonary Consumption	31·5	24·3
Other Constitutional Diseases	21·1	17·7
Total	52·6	42·0
Local Diseases:		
Brain and Nervous System	38·3	25·4
Heart and Organs of Circulation	13·4	12·4
Respiratory Organs	56·9	47·2
Digestive Organs	9·6	9·7
Other Local Diseases	6·0	7·2
Total	124·2	101·9
Developmental Diseases	35·8	24·1
Violent Deaths	6·7	8·0
Unclassified and Ill-defined	4·9	0·6
All causes	283·5	225·1

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At the commencement of these remarks I said, when speaking of the importance attached to the death-rate from zymotic diseases as a measure of health, that if I were to take the death-rate for any particular group of diseases, I would choose the constitutional, not the zymotic, as the test.

I would here again refer to the instances of Dublin and London as useful examples, the former being an unhealthy, the latter a healthy town population.

Table XIII gives a summary for ten years of the rate of mortality from various causes in Dublin and in London.

It will be observed that in nearly every instance the death-rate of Dublin is somewhat in excess of that of London; in many diseases the excess is small.

Thus, in the case of the zymotic diseases, the excess of Dublin over London is not, proportionately, nearly so great as in the case of constitutional diseases; in the former case the ratio is 59·3 to 48·5, in the latter 52·6 to 42·0.

Among the constitutional diseases we find that the death-rate per 10,000 from phthisis or pulmonary consumption alone is 31·5, against 24·3, and closely connected with this we find that the death-rate from diseases of the respiratory organs is 56·9 in Dublin, against 47·2 in London. This accords with my former remarks on the delicacy of the population of Dublin compared with London as measured by the effect of sudden falls of mean temperature on the death-rate of these two towns. I believe that the prevalence of the class of diseases termed "constitutional," as measured by the death-rates from these diseases, will be found to be a better gauge of the health of the community than the prevalence of any other single class of fatal affections, and in this sense these diseases may be truly termed "constitutional," whatever objection there may be to the term when viewed by the scientific nosologist.

My remarks have now extended almost beyond the limits which should be placed on an address such as this, and I shall not attempt to analyse the statistics which are available regarding the relations between marriage-rate, birth-rate and death-rate; but I think I may ask you to take my word for it that when these three rates do not bear a due proportion to one another in any given community there will be found to be serious defects in the health of that community, and not improbably a serious defect in its moral as well as its physical health. The relation between cleanliness and godliness is deeper than many who use the common proverb are aware.

In conclusion, I have a word to say about the contrast between the health of the inhabitants of town and country districts. I have recently been engaged upon an analysis of the returns of

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marriages, births, and deaths in Ireland for the ten years comprised between the census periods of 1871 and 1881. The report on this subject has been recently presented to Parliament, and will soon be in circulation. From this analysis I find that the deaths in the districts in Ireland, comprising towns with a population of 10,000 and upwards, during the decade were at the average annual rate of 225·1 per 10,000 of the inhabitants, while in the districts which comprised no considerable towns the rate was only 166·2 per 10,000. From the principal groups of diseases the rates were as shown in Table XIV.:—

TABLE XIV.—*Showing the death-rate per* 10,000 *of the mean population from certain causes in districts containing towns of a population of* 10,000 *and upwards; in rural districts; and in all Ireland for the* 10 *years* 1871–80.

Cause of Death.	Rate per 10,000 living.		
	In Town Districts.	In Rural Districts.	In all Ireland.
All causes	225·1	166·2	182·6
Small Pox	3·8	0·5	1·4
Measles	3·2	1·7	2·1
Scarlet Fever	6·5	3·5	4·3
Diphtheria	0·8	0·6	0·6
Whooping Cough	4·4	3·1	3·5
Fever	7·2	5·1	5·7
Erysipelas	0·7	0·5	0·6
Puerperal Fever	0·8	0·6	0·7
Childbirth	1·0	1·1	1·1
Influenza	0·1	0·2	0·2
Dysentery	0·5	0·5	0·5
Diarrhœa	5·6	2·6	3·4
Cholera	0·2	0·1	0·1
Phthisis or Pulmonary Consumption	27·7	16·4	19·6
Diseases of Respiratory Organs	38·4	22·6	27·0
Violence	5·2	3·4	3·9
Other causes and unspecified causes	119·0	103·7	107·9

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It is unnecessary to give a detailed analysis of this table, but it may be pointed out that the death-rate from nearly every cause is greater in the town districts than in the country districts. It is, however, specially worth noting that the deaths from consumption in town districts were at the rate of 27·7 per 10,000 of the mean population, and in the country districts the rate was but 16·4, and in diseases of the respiratory organs the ratio was for the former 38·4, and for the latter 22·6. I shall not venture to analyse any further the information contained in this report which will be in the hands of the public in a few days. I must now bring these remarks to a close, and trust that I have not occupied your time unprofitably in asking you to consider with me some of the *many* and not a few of the *most* important points we have to take into consideration when applying statistical measures as tests of the health of communities.

Sir Robert Rawlinson, C.B., the President of the Congress, hoped they would give a hearty vote of thanks to Dr. Grimshaw for his most instructive address. The figures Dr. Grimshaw had given would be useful for future reference and study. Great as the loss from sickness had been shown to be, if they had some of their teetotal friends there who could give a summary of the losses by excessive drinking, it would be found to amount to a much larger sum than the loss in the ordinary course by ill health. The rates of mortality in different towns were shown by the weekly returns of the Registrar General, and the variations last week were from 14 in the lowest, to 25 in the highest locality. A short time ago he had gone through the suburbs and outskirts of Liverpool, and had been shocked beyond measure with the misery and poverty to be seen on the streets. He saw children covered with dirt from their toes to the crowns of their heads, ragged almost to extreme nakedness, shoeless and stockingless. He had seen a similar state of things in Glasgow also, and he was sorry to say he had observed it likewise in Dublin. Children, pretty as angels, fair, flaxen-haired, and ruddy cheeked, rambling about the streets shoeless and stockingless! Was this state of things to continue? Surely not. There were the young roughs, the jail-birds, brought up from infancy to know nothing but poverty and vice, having no inducement but to live upon Society by thieving, lying, and all other ways that children left to their own devices would pursue. The depredations committed by these uncared-for children had really to be paid for by the classes above them. If their Sanitary Science was to be of any use to Society Sanitarians must go to the root of the matter and consider that it was a standing disgrace to civilisation to see bare-legged and naked children running about our streets as if they belonged to nobody. Men did not treat

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their animals in that way—they fed and housed them—and the only living creatures uncared for in our great so-called civilised country were the lower class children. This should not be, and he hoped we were beginning to see that it is our duty to commence at the lower strata of Society and to make improvements in the direction which he had indicated. It used to be considered in England that the Irish were more rowdy than the English, but judging from one of the diagrams prepared by Dr. Grimshaw, Englishmen were one-eighth more rowdy than Irishmen, for violent deaths were eight in England as compared with seven in Ireland. Of course "violent deaths" were of all kinds, but the fact showed clearly that in England they could not boast of their civilisation being superior to that of Ireland. They in England had even something to learn from Ireland.

On "The Administration of the Public Health Act in Ireland with Regard to the Duties of Officers of Health," by D. EDGAR FLINN, L.R.C.S.I., M.R.C.P., Surgeon to St. Michael's Hospital, Kingstown.

The subject about which I have the honour to address this section is one possessing some particular features of interest, and I trust it will not be presumptuous on my part to entertain the hope that the few remarks I have to offer on the working of the Public Health Act in Ireland with regard to the duties of officers of health will be of interest to the members of the Sanitary Congress assembled in this section.

Having held the appointment of medical officer of health in a district comprising a wide area in England for nearly six years, and having had considerable experience of the working of the English Public Health Act, I have been particularly impressed since my return to Ireland, two years ago, with the manner in which the sanitary laws appear to be carried out in Ireland, and it struck me that the present would be an opportune time to ventilate the subject of sanitary legislation in regard to the duties of health officers, and so court the opinions of those who take an interest in sanitary work. Now, I do not desire to appear as if finding fault with the administration of the Public Health Act in Ireland, but believing that the health and well-being of the people should be the first and most important aim of our legislators, and knowing that a vast deal yet re-

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mains to be done in this question of public health in Ireland, I trust this paper will be received in the spirit in which it is intended.

The working of the Public Health Act in Ireland has in a great majority of districts well nigh become a dead letter. One bright exception particularly stands forth, and that is the administration of the Sanitary Act in the City of Dublin, where, under the unwearying zeal of Dr. Cameron, the superintendent medical officer of health, the fever dens, the filthy court and lane ways, and the over-crowded tenement houses are fast disappearing, and the high rate of mortality which a few years ago prevailed, is gradually diminishing.

One of the main causes of the slow progress of sanitary reform in this country, is that there are no local boards nor combinations of districts; the boards of guardians are the sanitary authorities for the Irish rural districts, and though it cannot possibly be stated that they are as a general rule opposed to sanitary reform, yet they are never anxious to move in any measure of sanitary work that will cause any outlay, and are deep in their expressions of gratitude to their medical officers of health for not troubling them with verbose reports, which may involve them in a heavy, and in their opinion useless, expenditure on sewage, water, or other works, and so year after year the Public Health Act is systematically evaded.

It is well known that petty elective authorities in small Union districts are apt to obstruct rather than forward sanitary improvement of any kind, and for the most part they render any uniform and efficient system of administration almost impossible, consequently the medical officers of health and sanitary inspectors are powerless, and no doubt have great difficulties to contend with; but there is a central authority, the Local Government Board, which seems in Ireland to be unmindful of using the ordinary means in its power of enforcing the proper carrying out of the provisions of the Public Health Act.

It is a noticeable fact that the reports of medical officers of health or inspectors of nuisances seldom, if ever, appear in the public press in Ireland, and consequently the public are left in total ignorance of the state of the health, mortality, and other vital statistics of the immediate district or neighbourhood wherein they reside. These reports are frequently left unread and consigned to the nearest waste paper basket, as documents of a mere formal nature that require no special notice on the part of the sanitary authority. Why this wanton neglect? Because these reports contain truths difficult to digest. The medical officer of health may have dis-

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covered that there is not proper sewerage in some portion of the urban or rural district, or his attention may have been drawn to nuisances that exist which are dangerous to health. These are unpalatable subjects to be brought to the notice of the sanitary authority, and it is very possible that the parties who cause the nuisance, and whose property is liable to be taxed with the cost of constructing sewers or supplying a proper water supply, are members of the Sanitary Board, and actually the medical officer is reproved for attempting to conscientiously perform his duty.

The difference is apparent in England, where the recognized primary duty of the urban or rural sanitary authority is the health of the people, where the medical officer's report is read, duly discussed, and the suggestions offered for the improvement of the health of the district promptly acted upon.

What a disheartening prospect it is to a health officer to know that, time after time, his reports are unheeded, marked as read without being even looked at, and consigned to oblivion, and yet he is aware that nuisances dangerous to health exist in the midst of his district, that infectious diseases abound, and that, perhaps, he is on the eve of having to grapple with an outbreak of scarlatina, small-pox, or typhoid fever. There is no doubt much to discourage the sanitary officers from doing their duty fearlessly in Ireland, and to deter them from making painstaking reports; but still, notwithstanding these drawbacks, let them persevere and continue their efforts for the amelioration of the health of their districts, continuing to educate public opinion, and a time will come sooner or later when their efforts will be recognised, and they will reap a well-deserved reward.

There can be no doubt that the sanitary administration of districts (more especially in Ireland) in which the union medical officers act as medical officers of health, is very far inferior to that of districts which have secured, singly or in combination with others, the services of a single officer—of special qualifications for the post, at an adequate salary, and with a reasonably assured tenure of office. In England one of the main reasons why the Public Health Act is efficiently carried out, is the fact that the great majority of districts are now in combination, and are consequently able to command the services of a medical officer of health, at a fair remuneration, who does not practise his profession, whose duties are strictly limited to sanitary work, and who is consequently unfettered in his action and independent of the public around him. In Ireland, on the contrary, the dispensary or poor law medical officers are the medical officers of health, who receive a miserable dole of ten

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or perhaps fifteen pounds a-year, as a medical journal aptly puts it, to hold their tongues and take no notice of dirt and disease within their districts. These dispensary doctors are generally the medical attendants of members of the boards of guardians, who very probably are owners of property in their respective districts, and it is obvious that sanitary work is neglected.

The indications are rapidly becoming numerous that the Local Government Board in Ireland will soon have seriously to take up the whole question of combinations of districts and unions for the appointment of a medical officer of health. It is impossible that the sanitary laws can be efficiently worked in Ireland under the existing system. In lieu of having six or more medical officers of health in each district, with a superintendent medical officer of health (who, by the bye, is, as a rule, an ornamental functionary); there should be one, and only one, medical officer of health, who should be a man free from the cares of practice, and whose pecuniary interests would not be perpetually at war with a due and fearless discharge of his duties. In Ireland, again, the efficient carrying out of the details of the working of the Public Health Act seems, in the majority of the districts, to be encumbered by a plurality of executive officers, whose duties appear not to be very clearly defined, and, as a consequence, red-tapeism is in the ascendant, and the least possible amount of sanitary work is got through in the year. There is first an official termed a sub-sanitary officer, next an executive sanitary officer, then a medical officer of health, and finally a superintendent medical officer of health Surely Ireland ought to be a veritable land of health and happiness. It would be interesting to know what are the special duties appertaining to these various offices. In England one medical officer of health and one, at most two, inspectors of nuisances suffice (in the majority of districts) to carry out the provisions of the Public Health Act effectively.

I am informed, on reliable authority, that, in order to set the sanitary machine in motion, regarding the abatement of a nuisance, or other matter affecting the health of a district, each and every one of these officers has some little part to play, before the evil complained of can be remedied, and, as a consequence, it involves a period of weeks, months, and sometimes years, to carry out some trifling work of sanitation, which, in an English sanitary authority, would be effected in a few hours.

The dwellings of the poor in Ireland are a fruitful source of disseminating disease, over-crowded as they generally are, and neglected alike by the landlord and sanitary inspector.

It may be at once conceded that to abolish the one-roomed

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cabins, and replace them by decent cottages, will be impracticable as a measure of instant sanitary reform. This improvement must be effected, but it will be a work of time; there is no reason, however, why the commencement of this great undertaking should be indefinitely postponed. In the townships around the City of Dublin the habitations of the poor are simply indescribable, and reflect discredit alike on the landlords of the soil, the intermediary cottage property owners, and, above all, on the sanitary authorities, and the wonder is that these districts are not perpetually a prey to some withering outbreak of infectious disease.

Fever in all its varied forms is one of the greatest scourges which affects the poor in Ireland, and in the vast majority of instances it is produced by palpable neglect of some one of the provisions of the Public Health Act. The disease spreads throughout an entire district, many deaths ensue, no inquiry is made, and after a while the epidemic subsides, until a fresh and far more serious outbreak arises; and then at last the authorities awaken, a neatly worded report is issued, stating that "fever has been prevalent throughout the district, but by no means to such an extent as to give rise to public uneasiness." The question naturally arises—Where does the fault lie? Are the people responsible for the accumulated filth amidst which they live? Are the landlords accountable, or is the Sanitary Authority blameable? The question seems not easy of solution in Ireland; but if there be a Public Health Act in force, why are its provisions not strictly and properly carried out? Of what utility is the Sanitary Board if its bye-laws are not put into execution? Are the Medical Officers of Health and Inspectors of Nuisances merely ornamental functionaries? It is surely possible that some machinery can be set in motion in Ireland as well as in England, to abolish filthy dens of fever and filth, to eradicate existing nuisances, to isolate cases of virulent infectious disease, to cleanse the bye lanes and alleys as well as the principal thoroughfares, to prevent the overcrowding of tenement houses, to level down the miserable and unsightly half-roofed cabins of the poor, and raise comfortable cottages in their stead; in fine, to educate the people into acts of cleanliness.

The defective state of the dwellings of the poorer classes in Ireland stands forth as a glaring disgrace to the landlords and sanitary authorities throughout the entire country. Cottages or cabins are built of unhewn stones without cement, looking as if they could scarcely hold together; the gaping chinks admitting every blast, the thatch gaping in some parts to admit the wind and wet; before the doors run open drains full of animal and

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vegetable refuse, decomposing, and breeding disease around. Contiguous to the door the dung heap, on which every kind of filth is accumulated. Within this miserable dwelling, containing most probably only one room, are huddled together a family of perhaps a dozen souls, thankful that they have even an earthen floor to lie upon, and still there is a Public Health Act supposed to be in force in Ireland. The fault lies somewhere, and possibly it can be brought home to the door of the administration of the sanitary service in Ireland.

Dr. Laffan, in his Carmichael prize essay referring to the administration of the sanitary service in Ireland, remarks: "There is no use in disguising the fact that there is a direct antagonism between the interests and the duties of Irish sanitary officers. An independent discharge of his duties would place every dispensary officer at war with half his clientele: it would be too much to expect from human nature, that any man so circumstanced could discharge his duties properly. No class of men make more personal sacrifices for the public interest than the members of the medical profession, but there is however a limit to such sacrifice-making, and it is neither desirable nor proper to impose burdens which try our human nature too much. We therefore entirely disapprove of the arrangement which imposes sanitary duties on Irish dispensary officers." Further on Dr. Laffan says, "We deem an ex-officio system of appointments to any place or post open to grave practical objections, nobody will venture to deny that considerable special training is needed to produce a competent sanitary officer, indeed the ex-officio system renders this impossible. Another obstacle to sanitary work has been found in the nominal pay given to the staffs, no man receiving such paltry stipend could be reasonably expected to bestow that labour on the sanitary portion of his duties, which their onerous nature would require. There must be a clean sweep of our Irish system of sanitary organisation. Dispensary medical men should be relieved of functions, with which they never should have been entrusted." These sentiments I am sure will be approved by many here present, and the sooner the Local Government Board faces the question of combination of unions and districts for sanitary purposes the better. There must be only one medical officer of health to each union, whose duties will be strictly limited to sanitary work. He should be an officer specially trained, properly remunerated, and thus rendered independent and untramelled in the discharge of his duties.

In the quarterly reports of the health of Ireland, the Registrar's notes are often interesting as showing the prevalence of disease, and the sanitary conditions under which the inhabitants of their respective districts are placed. Many refer to the

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accumulation of manure and the existence of cesspools as causes of disease, more especially typhoid fever. For example, in one district 209 cases occurred, clearly traceable to water contaminated with dejecta from a typhoid patient, another registrar states that he has reported more than 400 nuisances during the past year and-a-half, but has not succeeded, save in one or two instances, in having them removed. Another registrar states that cesspits, with manure heaps in close proximity to dwelling houses, are the rule in his district, while cattle are kept in a great many houses, and the water supply is unfit for use, but, notwithstanding his reports, nothing is done to improve the condition of affairs. A medical officer of health writes to me that his district, so far as its sanitary condition is concerned, is in exactly the same state as it was ten years ago. No notice whatsoever is taken of his reports by the sanitary authority, and he is forced to the conclusion that it is only in the very distant future that any approach to sanitary reform will be attempted in his district, although it is a large and important one, he states that recently he had to treat some patients suffering from typhus fever, in a room about twelve feet square, where nine others slept during the night.

Another Medical officer of health states, in a recent letter, that the town and district where he resides, is visited frequently with typhus and typhoid fevers, which he attributes to the fact that the water in use for drinking purposes is "infamously bad." The supply is obtained in great part from open wells, which are entirely unprotected from contamination, and although he has time after time called the attention of his sanitary board to this defective water supply and other sanitary faults, yet nothing is done, and possibly this will be allowed to continue until the end of time. Probably Macaulay's New Zealander will see these works of public health commenced but not ended in Ireland. Hence it is evident that the duties of a sanitary officer in Ireland are of no ordinary character. On the one side he has an unwilling sanitary authority opposed to all measures of health reform, bitterly hostile to any sewage, water, or other scheme that may involve an expenditure from their incomes; and on the other side a disinclination on the part of the people to submit to sanitary legislation, and accustom themselves to habits of cleanliness.

The duties of health officers in England contrast with advantage when compared with the duties of health officers in Ireland, and, as a rule, the former officers find comparatively little difficulty in carrying out the provisions of the Public Health Act. Of course there are exceptions to every rule, and strenuous opposition is frequently offered to a sudden and

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sweeping measure of sanitary reform, but generally speaking, the reports and suggestions of the medical officer of health are acted upon, and carried out without delay. This contrasts with the Irish health officer, who, when he earnestly and conscientiously performs his duty and attempts to improve the sanitary condition of his district, is blamed for his officiousness, and is given to understand that the less frequently he favours the Sanitary Committee with his reports the more will he rise in their estimation, and the greater will be his peace of mind. These gentlemen seem to forget that the first function of every health officer is to consider well how health may be saved, and what provisions are necessary for its protection, they seem to be unaware of the fact that his noble duty is to protect the health of every human being residing within his district from known sources of danger, and to advise to the best of his ability what steps and sanitary arrangements are to be carried out to prevent the outbreak of infectious disease.

It is generally admitted that the working of the Public Health Act in Ireland is impeded by the ignorance and incapacity of those who are called upon to carry out its provisions, yet there has been a decided improvement in some towns and districts during the last few years, and it is to be hoped that this improvement will continue and extend over the whole of the country. Until such time as Boards of Guardians, Town Councils, and Town Commissions begin to recognise the principle that the health of the people should stand pre-eminently first in the rota of local legislation, so long will the working of the Public Health Act in Ireland remain a dead letter, so long will the high rate of mortality exist throughout the country, and so long will fever and infectious disease stalk uninterruptedly throughout the urban and rural districts.

The enforced brevity of this paper precludes my discussing this question further, it is an extremely difficult one and not easy of solution in Ireland. Possibly, it may be from want of capital that sanitary reform is not carried out more vigorously in the unions and districts in this country. Still, the progress of civilization makes this question of sanitary reform every day more pressing, and local authorities are becoming forced to abandon the *laissez faire* principle, and to recognise their responsibilities as the guardians of the public health. Year by year improvements of a social and sanitary nature demand a supply of skilled knowledge for their most effective administration, and the legislative era of the sanitarian of thirty years ago has passed away. To help in the great problem of sanitary progress and reform is a high and a noble task, and it is one which above all others should be dear to the officers of health.

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The fertile fields of this new land of loving labour lies before them in all its fruitful freshness, let them have the courage to claim possession of it in the name of a high and holy cause —the health and happiness of the Irish people.

Mr. H. H. Collins, F.R.I.B.A. (London), said it might be supposed from the observations that had been made, that the medical officers of health in London had quite an easy task as compared with that of the medical officers of health of Ireland, but he had thought the address of the President last night would quite have dissipated that impression. The truth was that there existed amongst the masses of the population a lamentable apathy with regard to sanitary matters, although during the last twenty-five years there had been enough books written on Sanitary questions to fill that building, and despite the fact that such men as their President, Mr. Edwin Chadwick, Dr. Cameron, and others had been pressing this matter upon the people at large, it was extraordinary how very little real interest the question had aroused. Only those who had to administer the laws relating to sanitary matters could understand or appreciate the difficulties experienced in carrying them out. If a person noticed a disagreeable odour in his house he usually sent for a plumber, who probably, from ignorance or design in endeavouring to rectify defects, made them worse. One of the main objects of this Association was to prevent unqualified persons from assuming duties and undertaking to carry out the enactments contained in Acts of Parliament without the least fitness for their position; and it offered by the most highly qualified examiners to ascertain whether inspectors had acquired sufficient knowledge to enable them to perform their different duties; and to supply them (if efficient) with a certificate, which would not be merely a written testimonial, but would represent that they had an absolute knowledge of the subjects they professed as connected with principles of Public Sanitation.

Corporations in large towns were beginning to see that sanitary efforts were in a great measure nugatory, unless they could embrace within their control the outlying districts, and in London it had long been felt that there should be no distinction between urban and rural sanitary authorities. He had long since come to the conclusion that to educate the people into a knowledge that the neglect of such matters as Dr. Flinn had so ably brought before them, meant the taking of so much money out of their pockets, was the best way to lead to the enforcement of these laws.

Dr. Alfred Carpenter (Croydon) wished to confine the discussion to the question raised by Dr. Flinn's paper—viz., the difficulty of getting the Public Health Acts carried out in Ireland. It should be borne in mind that the great object of the Sanitary Institute in

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holding these Congresses was the education of the people; and when he looked at that meeting and saw the number of persons who were anxious to learn and know something of sanitary laws, he was satisfied that sanitary progress was being made in Ireland. If they could get a spirit of enquiry diffused among the people as to the advantages that followed the adoption of sanitary arrangements much more good would be done than by a process of compulsion. The principles of sanitary law would be carried out much better in those districts where the people knew that these laws were for their advantage, and where they felt it was to their interest to attend to them, than in districts where they were compulsory; and wherever there was that favourable idea of the law, no difficulty would be experienced in obtaining proper sanitary inspectors. No doubt there were places in England, as well as in Ireland, where there were difficulties experienced in carrying out the sanitary laws, but he did not think there were any similar cases to that referred to by Dr. Flinn, in which typhus fever patients were treated in a small room, wherein many others slept during the night. It was only by "pegging away," as President Lincoln said, that sanitary reformers could get attention paid to them, and he trusted the visit of the association to Ireland would arouse a spirit of enquiry which would lead to the disappearance of those evils which had been brought under notice.

Dr. Charles A. Cameron (Dublin) thought they were much indebted to Dr. Flinn for bringing this matter before them. He was disposed to agree with the views of the author. So far as he could ascertain, it was the universal opinion of the officers of health themselves that the Public Health Acts were not being carried out at all in the rural districts of Ireland. Those officers were not able to carry out Acts, and the reports that they sent in were not attended to. He should not like to be considered as unpatriotic, and he hoped he should not be taken as abusing his fellow-countrymen, but boards of guardians, as a rule, were not at all anxious to carry out the Sanitary Acts. This was especially true in regard to water-supply, as he hoped to have an opportunity of showing in the geological section. A most appalling state of things existed in regard to the water-supply of the greater part of Ireland, and this arose from a disinclination to spend money. He could fully confirm the observations of Dr. Flinn, that sanitary administration was not properly carried out in many of the small towns in Ireland. In England most towns of 3,000 or 4,000 people would have a supply of water at high pressure, but few towns in Ireland of even 7,000 or 8,000 inhabitants had this. In an Irish town of 3,000 inhabitants they would probably find a magnificent organisation of town commissioners, town clerk, medical officer of health, inspector of nuisances, and other officers; but perhaps the revenue of this great organisation did not exceed £50 or £60 a year, and the whole of it must be expended in payment of officers, leaving nothing for the carrying out of sanitary works. One gentleman whom he knew bore the high-sounding title of "Superin-

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tendent Medical Officer of Health," but had no one to superintend, and he had been promoted from the position of "Consulting Medical Officer of Health," which office also carried with it no duties. This gentleman had made no reports since his promotion, because his reports as consulting medical officer were not attended to. He (Dr. Cameron) thought they were greatly indebted to Dr. Flinn for bringing this subject before them.

Mr. R. O'Brien Furlong (Dublin) expressed concurrence for the most part with the observations which had fallen from Dr. Flinn, but could not agree that the duties of English medical officers of health were so free from embarassment as Dr. Flinn's observations might lead them to suppose. In Ireland the results of the Public Health Acts had not been so satisfactory as might have been expected, but then it must be remembered down to the year 1874, when Sir Michael Hicks-Beach introduced the Public Health (Ireland) Act, there was practically no sanitary organisation in the country; there was an utter want of control, and the sanitary state of the country was about as bad as bad could be. The Act of 1874 utilised the existing poor law machinery, and dispensary medical officers were appointed ex-officio medical officers of health for their respective districts. That did not meet with general approval, but upon the whole it was the best arrangement that could have been then made. Boards of Guardians were not doing all that could be desired, but they were doing infinitely more than had been done under the old system. He was not prepared to approve such a step as the abolition of the ex-officio sanitary functions of the dispensary medical officers. They could hardly obtain the services of an independent medical officer for each union, as Dr. Flinn proposed, for less than £800 a year, and as there were 163 unions in Ireland, the expense would render such a proposal almost impracticable. The State should appoint and pay six or eight superintendent medical officers of health, each of whom should reside in a central position in his district, and should be responsible to the Local Government Board for the carrying out of the sanitary laws in his district. These officers would no doubt support the local officers, and enforce the carrying out of their recommendations by the local boards. The Local Government Board of Ireland might well give its attention to the amalgamation of districts. It was unfortunate that there was not a health department attached to the Local Government Board for Ireland. There was a staff of medical inspectors attached to the English Board, whose duties were distinct from those of the general inspectors, and he could not see why they should not have a similar arrangement in Ireland. It was not correct to say that nothing was being done in the rural districts. Large, and annually increasing sums were being lent to the local bodies for sanitary improvements, but it must be remembered that the ratepayers elected the guardians, and the latter, who made the rates, would not be again returned if the rates were too high. Such congresses as these brought such

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questions prominently before the people, who could then see that they might be saving their pockets at the expense of their health.

Surgeon-General A. C. C. De Renzy, C.B. (Bray), was of opinion that there was a great mass of the population in this country, as in India, who believed that it was utter nonsense to suppose you could add one single hour to human life or avert one hour's sickness. This was, no doubt, the reason why Boards of Guardians were unwilling to spend money on sewerage and water supply, or anything of the kind. Members of the Sanitary Institute believed, and rightly, that death and disease could be largely controlled, but the mass of the people did not hold that view, and that was why Boards of Guardians and other similar authorities refused to allow the rates to bear the necessary expenditure. It was desirable, he thought, to retain the dispensary medical officers in the position they now occupied, for he believed they were performing a very useful function in educating Boards of Guardians in sanitary matters. By and by these Officers would succeed in making Guardians understand that sickness was to a large extent preventible, and that by taking proper measures the duration of human life might be lengthened; and there would then be less difficulty in inducing the local authorities to grant the necessary funds.

Sir Robert Rawlinson, C.B. (President of the Congress) wished to make some remarks on the difference between Ireland and England in this matter. The Irish Act had, he believed, been adopted mainly from the English Public Health Act, but in Ireland the engineering officer stood *solus*, and had no staff like he himself had in England, and he assumed that the medical officer in Ireland stood in the same position as the engineering officer. In Ireland, expense must be considered; that he fully admitted. England was a very much richer country than Ireland, both geographically and geologically. Ireland had not underneath her surface the stores of riches that were to be found in England. Economy in sanitary works ought therefore to be striven for. There ought not to be extravagance in England, but wealth and extravagance could not in all cases be kept separate, and some works devised and executed by English municipal bodies were extravagant. Applications for sanitary works of an engineering character made to the Local Government Board came before him, and he had looked at some of them with a heartache when he saw that the estimates represented a sum of money greater than the rateable value of the district. Sometimes there were reasons, especially in growing places, for incurring a heavy expenditure, but if a similar amount of expenditure were sanctioned in Ireland it might amount to confiscation. In Ireland there should be men especially adapted for Irish work. Dr. Cameron had told them that in many towns of Ireland there was scarcely such a thing as a good water-supply, and probably if some great engineers were applied to they would recommend a reservoir, mains, and a distributing apparatus, all of a most expensive character. The first question in

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Ireland should, however, not be how an extravagant work of that description could be done, but how in the roughest and readiest manner to be efficient, water could be brought into a district, if not in the most perfect manner, yet in a far better manner, than at present; and this could frequently be done at a cheap rate. Gas-pipes from two inches to one inch in diameter might be laid from mountain springs or lakes, and if there were a gravitating fall down to a town of 1,000 or 1,500 people, such pipes would bring in the twenty-four hours more water than would supply such a population if it were distributed properly, cheaply, and wisely. He had carried out works in England in such a manner that the poorest family could be supplied with as much pure water as could be required for the sum of ninepence per quarter.

Prof. F. DE CHAUMONT, M.D., F.R.S. (Southampton), agreed with Sir Robert Rawlinson, that Ireland would do well to take warning by the large expenditure incurred in England, in many cases unwisely; but in England they had been feeling their way, and Ireland could gain from their experience. One point which could not be dwelt upon too strongly was the necessity for medical officers of health being independent of the local bodies. If they had to deal with England only, he should say distinctly that the medical officers of health in any district ought to be prohibited from practising, and should receive an adequate salary accordingly; but there would be a difficulty in carrying out such a scheme in Ireland, on account of the smaller rateable value, though an extra charge upon the rates for such a purpose would not be money entirely lost, owing to the diminished expenditure in respect of poor houses and asylums, and, he hoped, of prisons.

The roseate view taken by Dr. Flinn of the working of the English Public Health Act was hardly borne out by experience, for in many cases where Boards of Guardians were the Sanitary authority, it was extremely difficult to get anything done.

Dr. EDGAR FLINN (Kingstown), in reply, justified by his own experience his assertion as to the working of the English Public Health Act, and maintained that the Sanitary laws would never be properly carried out in Ireland, until they had an independent medical officer of health, adequately remunerated, who could give all his time and attention to the duties of his office, without fear or favor. He thought that the discussion had shown that the time was opportune for ventilating this most important question, and he hoped that at no distant date a new and vigorous era would be initiated in the administration of the Public Health Act in Ireland; for truly (so far as his experience went) reform in this direction was urgently and imperatively needed throughout the entire country.

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On "The Public Health of Kingstown," by J. BYRNE POWER, M.C.S.S., C.P.I., Physician, St. Michael's Hospital, Kingstown.

My duties as Medical Sanitary Officer have led me to investigate, as far as lay in my power, the sanitary condition of Kingstown. The Registrar-General's Returns pointed to two facts which seemed to me anomalous in such a town, *i.e.*, a sea-side resort for the well-to-do inhabitants of a large city. The points I noticed were, a very low birth-rate and a relatively high death-rate; I say relatively high, as I consider the death-rate excessive, taking into account the very favourable conditions, as to health, which ought to obtain in a town of this class. The results as to the births were particularly startling, as during the years 1882 and 1883 the deaths in the township exceeded the births by seven and twelve respectively. As bearing on this point, I have thought it well to compare the vital statistics of Blackpool—a seaside pleasure-resort near Liverpool, and in that respect comparable with those of Kingstown—for the census year 1881, and I find the following results:—

Blackpool birth-rate	30·6
Kingstown birth-rate	21·8
Blackpool death-rate	18·6
Kingstown death-rate... ...	19·2

So that, roughly speaking, we may say that for three children born at Blackpool, there are only two born at Kingstown. The Kingstown death-rate is not much in excess of that of Blackpool, but I regret to say that, in my opinion, the Kingstown death-rate always appears less than it ought to be, in consequence of the large number of the poorer inhabitants dying in the Rathdown workhouse, whose deaths are not registerable in Kingstown. Moreover, I will further on give my reasons for concluding that the population of Kingstown decreased considerably between the years 1880 and 1883. This decrease would cause the apparent death-rate to be lower than the real one, though of course it would affect the birth-rate in the opposite direction. My first object of inquiry was to ascertain if there was anything in the physical conditions of Kingstown to account for this abnormal state of affairs. The principal physical conditions affecting the public health of any community

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are: climate, soil, water-supply, and drainage. I shall now proceed to consider the climate of Kingstown as indicated by mean temperature, range of temperature, direction of wind, and rainfall.

TABLE I.—*Mean Temperature, Kingstown.*

Year	January	February	March	April	May	June	July	August	September	October	November	December	Annual
	°	°	°	°	°	°	°	°	°	°	°	°	°
1873	44·3	39·9	42·9	46·7	51·6	58·9	61·3	60·7	55·0	49·6	47·1	47·7	50·5
1874	44·3	44·0	46·9	50·8	52·0	56·6	62·6	59·8	57·2	51·7	48·2	39·2	51·1
1875	46·8	42·4	44·0	48·3	55·0	57·0	58·8	62·5	59·0	50·4	45·8	42·4	51·0
1876	44·6	43·8	41·1	46·4	50·2	56·5	61·9	60·4	55·1	53·7	46·8	45·5	50·5
1877	44·1	45·3	42·0	45·9	49·3	58·2	59·0	58·9	54·5	51·9	46·6	43·7	49·9
1878	43·5	44·5	44·7	47·6	53·0	57·9	61·4	60·7	57·2	52·6	39·8	35·1	49·8
1879	36·5	39·8	42·3	44·1	48·2	55·3	56·9	58·2	55·0	50·4	45·5	39·7	47·6
1880	40·2	46·1	46·7	48·5	52·1	57·2	59·5	62·1	60·4	52·9	46·2	44·0	51·3
Means	43·0	43·2	43·8	47·3	51·4	57·2	60·2	60·4	56·7	51·6	45·7	42·2	50·2

The mean temperature at Kingstown, given in Table I., is remarkably high. In Table II. will be found a comparison between the mean temperature at Kingstown during the winter months and at the different favourite winter health resorts in England and the Channel Islands for the years 1873-77.*

TABLE II.—*Mean Temperature During Winter Months.*

STATIONS.	Nov.	Dec.	Jan.	Feb.	March	Means
1873-7.	°	°	°	°	°	°
Scilly	50·1	47·1	47·8	46·9	47·5	47·9
Torquay	49·0	45·5	46·6	44·2	46·4	46·3
Penzance	47·6	45·3	45·9	45·0	45·3	45·8
Guernsey	48·4	44·4	45·3	43·4	43·3	45·0
Barnstaple	46·6	43·1	45·0	43·8	44·5	44·6
Kingstown	46·9	43·7	44·8	43·1	43·4	44·4
Ventnor	47·7	42·7	44·8	42·8	44·0	44·4
Llandudno	45·1	42·9	44·1	42·3	43·3	43·5
1874-7.						
Ramsgate	44·1	40·1	41·5	39·8	41·8	41·5
Hastings	44·1	39·7	41·6	40·0	40·8	41·2
Means	47·0	43·4	44·7	43·1	40·0	44·5

* All the meteorological data of stations in England and the Channel Islands contained in Tables II., IV., V., and IX., have been taken from a paper by John W. Tripe, Esq., M.D., published in the Quarterly Journal of the Meteorological Society for April, 1878. All the meteorological data of Kingstown are taken from a paper I published in the *Dublin Journal of Medical Science*, February, 1881. I have not considered it necessary, for the purpose of comparison, to continue the Tables down to the present date.

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From this it will be seen, as regards mean temperature, that Kingstown occupies a position equal to that of Ventnor.

As regards range of temperature, it will be seen on reference to Table III. that the diurnal range of temperature at Kingstown during the whole year is remarkably small.

TABLE III.—*Mean Diurnal Range of Temperature—Kingstown.*

Year	January	February	March	April	May	June	July	August	September	October	November	December	Means
	°	°	°	°	°	°	°	°		°	°	°	°
1873	7·8	7·6	8·0	8·9	8·8	10·5	10·7	9·7	10·9	10·2	7·2	6·1	8·9
1874	9·2	7·2	9·7	10·9	8·6	10·6	10·2	10·3	9·2	9·1	7·8	7·7	9·2
1875	7·2	6·4	6·5	9·4	11·5	10·7	10·0	9·0	9·3	10·8	7·3	5·7	8·6
1876	6·5	7·2	8·8	8·4	8·0	10·0	10·9	9·6	7·9	5·9	6·0	6·5	8·0
1877	8·8	8·2	8·5	6·5	7·4	9·8	9·9	8·4	8·4	9·3	8·2	7·6	8·4
1878	7·8	6·0	8·5	8·2	9·2	7·3	9·3	8·0	9·4	7·8	9·2	7·2	8·2
1879	6·4	6·7	11·3	9·2	11·8	12·0	10·9	13·0	12·0	10·0	7·0	10·7	10·1
1880	9·2	10·2	12·8	11·4	12·7	14·3	14·0	6·4	5·0	11·4	10·6	9·5	10·6
Means	7·9	7·4	9·3	9·1	9·7	10·6	10·7	9·3	9·0	9·3	7·9	7·6	8·9

This fact, as regards its bearings upon the public health, is of the greatest importance, for there is no doubt that great and sudden changes of temperature are very trying to most constitutions. On reference to Table IV., we find, as regards this important matter of daily range during the winter months, that Kingstown occupies a most favourable position when compared with the favourite winter health resorts in England and the Channel Islands, being only inferior in this respect to two stations—Scilly and Penzance.

TABLE IV.—*Temperature. Mean Daily Range.*

STATIONS.	Nov.	Dec.	Jan.	Feb.	March	Means
1873–77.	°	°	°	°	°	°
Scilly	4·9	6·1	6·3	5·4	7·1	6·0
Penzance	6·2	5·2	5·4	5·3	7·6	6·0
Kingstown	7·3	6·7	7·9	7·3	8·3	7·5
Guernsey	7·4	7·6	7·8	7·5	9·1	7·9
Ventnor	8·7	6·7	7·0	7·7	9·9	8·0
Torquay	9·3	9·0	8·2	7·6	10·1	8·8
Llandudno	8·6	8·0	10·1	9·2	11·3	9·5
Barnstaple	10·1	9·1	9·4	9·0	11·1	9·8
1874–77.						
Hastings	8·9	6·3	7·4	7·8	10·4	8·1
Ramsgate	9·8	7·9	10·2	8·3	11·8	9·6
Means	8·1	7·3	8·0	7·5	9·7	8·1

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TABLE V.—*Temperature. Monthly Range.*

STATIONS.	Nov.	Dec.	Jan.	Feb.	March	Means
1873–77.	°	°	°	°	°	°
Scilly	18·5	18·5	18·2	18·0	20·5	18·7
Penzance	23·2	21·7	18·1	21·0	22·4	21·3
Guernsey	23·7	24·2	22 2	22·1	25·8	23·6
Kingstown *	23·8	27·14	24·8	24·0	25·4	25·1
Ventnor	28·7	25·2	21·5	23·0	27·7	25·2
Torquay	27·2	26·2	23·0	24·7	25·4	25·3
Llandudno	29·3	27·0	28·5	28·5	28·1	28·3
Barnstaple	31·8	29·8	28·1	25·0	30·3	29·0
1874–77.						
Hastings	29·4	26·8	26·9	26·3	29·5	27·8
Ramsgate	32·3	32·3	32·6	30·7	28·9	31·4

In Table V. I have compared Kingstown with the above-named English and Channel Island stations as regards monthly range of temperature, from which it will be seen that Kingstown enjoys an advantage in this respect over all the stations in England excepting Penzance.

As showing the absence of extremes of low temperature during the winter months at Kingstown the following particulars are worthy of note:—During the severe frost of December, 1879, the thermometer descended as low as 22·6° at Torquay, 22° at Ventnor, 20·9° at Ramsgate, 19° at Bournemouth and Eastbourne, and 17·6° at Hastings, while at Kingstown and Llandudno it only reached 23°. During the same month the thermometer stood below 32° on 24 days at Ramsgate, on 21 days at Hastings, on 20 days at Eastbourne, and on 19 days at Torquay and Bournemouth, while it only fell below 32° on 12 days at Kingstown, on 11 days at Ventnor, and on 10 days at Llandudno.†

We next come to consider the subject of the direction of the wind; and for this purpose I have compiled Table VI., giving the number of days in each month from January, 1873, to December, 1880, upon which the wind, at a fixed hour each day, blew in a certain direction at Kingstown. In constructing this Table I have considered it well to distinguish the land from the sea breezes, or, in other words, the westerly from the

* The Monthly Ranges for Kingstown are calculated for the years 1876-80, and are therefore not strictly comparable with those for the years 1873-77.

† On the Frost of December, 1879, over the British Isles. By William Marriott, F.R.Met.Soc. Quarterly Journal of the Meteorological Society, April, 1880.

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easterly winds, as the distinction may have an important influence on the public health.

TABLE VI.—*Direction of Wind at Kingstown for Eight Years, 1873–80. Number of days it blew at 11 a.m, or at 1.30 p.m. in certain directions.*

MONTHS	Total Sea Breezes	N.	SEA BREEZES			S.	LAND BREEZES			Total Land Breezes	CALMS
			N.E.	E.	S.E.		S.W.	W.	N.W.		
January	38	8	1	22	15	86	8	100	4	112	4
February	52	16	1	28	23	48	4	74	13	91	2
March	86	24	13	47	26	33	4	84	17	105	5
April	83	37	11	52	20	54	5	44	7	56	1
May	105	37	9	73	23	35	7	53	10	70	1
June	81	21	9	43	29	63	12	53	12	77	8
July	68	23	2	36	30	39	5	89	16	110	1
August	91	12	9	59	23	47	3	84	11	98	0
September	62	18	7	37	18	44	10	75	17	102	5
October	60	26	6	33	21	45	7	88	19	114	4
November	56	20	10	34	12	44	5	91	19	115	5
December	32	8	2	18	12	46	12	132	10	154	7

On looking over this Table the first point that strikes us is the great prevalence of westerly and southerly winds, which is in accordance with the result of all observations in these countries. The easterly winds, proverbially harsh in these islands, fortunately for us occur in minimal frequency during the two coldest months of the year—January and December—not attaining their maximum at Kingstown until so late as the month of May, in fact, during the summer months they are vastly more frequent than during the winter. Even assuming that the east wind is pernicious, the fact of its prevalence during the early summer months—the portion of the year in other respects most favourable to health—might lead us to anticipate that its effect would be but slightly traceable in the death-rate; and this we find to be the case on reference to Table VII., which gives the number of deaths from all causes, and also those from diseases of the respiratory organs and phthisis, for four weeks in each month from January, 1873, to December, 1880. This is illustrated by Diagrams I. and II.

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DIAGRAM I.—*Showing Average Number of Deaths in Kingstown from all Causes, and from Diseases of the Respiratory Organs and Phthisis, for four weeks in each month, from January,* 1873, *to December,* 1880.

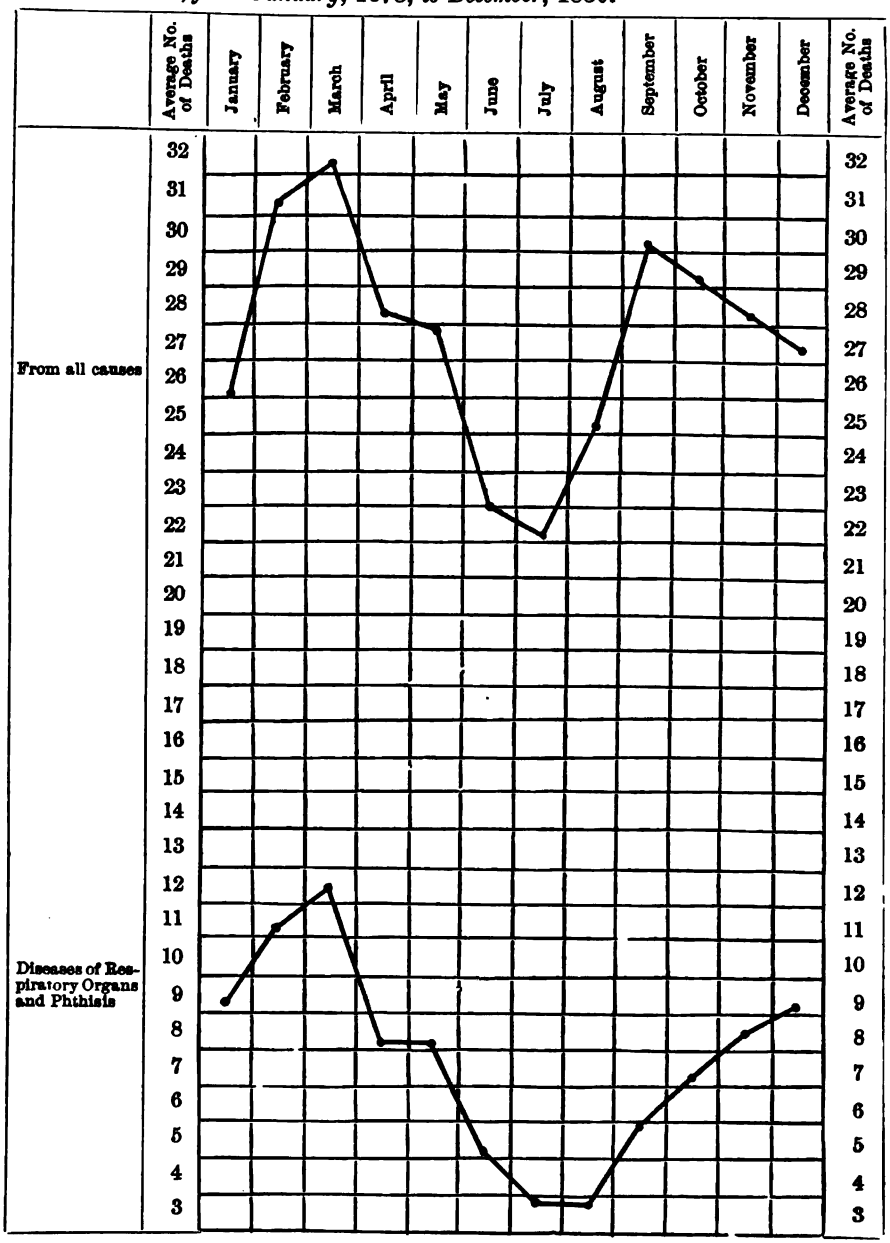

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DIAGRAM II.—*Showing Prevalence of Easterly Winds at Kingstown, during Eight Years, from* 1873 *to* 1880.

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TABLE VII.* *Number of Deaths in Kingstown from all causes for four weeks in each month, from January,* 1873, *to December,* 1880.

Year	January	February	March	April	May	June	July	August	September	October	November	December
1873	16	14	35	23	14	22	14	15	30	26	22	21
1874	21	35	30	28	14	18	19	23	23	20	23	28
1875	25	25	18	26	21	15	23	25	36	30	26	27
1876	23	31	33	29	22	21	27	19	33	30	41	32
1877	36	37	49	30	37	26	23	23	20	32	26	22
1878	25	35	23	25	27	22	23	40	27	40	26	32
1879	39	43	31	37	50	33	29	20	23	39	22	27
1880	23	32	41	28	39	29	21	40	53	21	40	31
Average	26·0	31·5	32·5	28·2	28·0	23·2	22·4	25·6	30·6	29·7	28·2	27·5

Deaths from Diseases of Respiratory Organs and Phthisis for four weeks in each month, from January, 1873, *to December,* 1880.

1873	8	5	16	6	2	3	5	3	6	6	4	5
1874	8	11	9	5	4	5	2	3	3	4	5	10
1875	9	13	7	11	3	3	2	1	7	3	8	6
1876	8	13	16	12	7	4	3	2	5	4	9	10
1877	14	14	22	12	23	8	7	6	5	6	10	7
1878	13	11	7	4	8	4	5	0	3	9	8	16
1879	10	18	12	10	12	12	4	5	8	14	7	11
1880	5	7	11	5	9	2	3	10	10	11	14	7
Average	9·4	11·5	12·5	8·1	8·5	5·1	3·9	3·7	5·9	7·1	8·1	9·0

As regards rainfall, Table VIII. gives the monthly rainfall at Kingstown, from the year 1873 to 1880.

TABLE VIII.—*Rainfall in inches—Kingstown.*

Year	January	February	March	April	May	June	July	August	September	October	November	December	Yearly Rainfall
1873	3·51	0·66	2·90	0·55	1·12	0·68	3·18	3·93	2·17	2·43	1·39	0·50	23·02
1874	2·03	2·93	0·68	1·11	1·45	0·99	2·41	4·52	1·86	2·55	3·69	3·68	27·90
1875	3·47	1·93	0·99	0·98	1·17	2·39	2·18	1·53	3·83	7·13	3·68	1·08	29·86
1876	0·34	3·13	2·05	1·74	0·67	1·55	0·82	2·56	3·05	4·77	4·54	8·09	33·31
1877	5·02	1·11	2·67	5·02	1·92	1·18	2·97	3·91	2·00	2·11	1·97	2·08	31·96
1878	1·97	1·57	1·02	1·78	4·70	3·29	0·44	6·49	1·92	1·79	0·86	1·47	27·30
1879	2·16	3·86	1·76	2·03	2·03	4·59	3·35	3·06	2·06	1·26	1·41	1·10	28·67
1880†	0·80	3·08	3·54	1·82	0·70	2·34	7·18	1·73	3·30	6·36	2·93	3·35	37·13
Means	2·41	2·28	1·95	1·88	1·72	2·13	2·82	3·47	2·46	3·55	2·56	2·67	29·89

* This Table has been compiled from the official monthly returns, kindly placed at my disposal by the present Registrar-General.

† The rainfall at Kingstown during 1880 was excessive. The greatest

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It will be seen that the wettest of those years at Kingstown was 1880, in which 37·13 inches fell; the driest being 1873, in which 23·02 inches fell. The two wettest months during those years were August and October. The two driest months at Kingstown were April and May. The greatest monthly rainfall at Kingstown was that of December, 1876, amounting to 8·09 inches; the smallest that of January, 1876, being only 0·34 inch.

In Table IX. I have compared the average rainfall at Kingstown during the winter months with that at the above-named English stations, for the years 1873–77. From this it will be seen that the rainfall at Kingstown during the winter is considerably less than that at any one of those stations, and amounts to little more than half that at Penzance.

TABLE IX.—*Monthly Rainfall.*

STATIONS.	Nov.	Dec.	Jan.	Feb.	March.	Totals.
1873-77.	In.	In.	In.	In.	In.	In.
Penzance	5·04	6·14	5·97	3·53	2·84	23·52
Guernsey	5·52	5·84	3·96	2·74	2·34	20·40
Barnstaple	3·97	4·37	4·89	2·54	2·68	18·45
Torquay	4·48	4·31	4·37	2·99	2·13	18·28
Scilly	4·12	4·98	3·92	2·13	1·98	17·13
Llandudno	4·24	2·86	4·04	2·69	2·13	15·96
Ventnor	3·89	3·01	3·84	2·41	1·87	15·02
1874-7. Hastings	3·90	3·60	4·08	2·24	2·06	15·88
1874-7. Ramsgate	3·82	3·12	3·12	2·19	2·11	14·36
Kingstown	2·97	3·09	2·93	1·94	1·76	12·69
Means	4·19	4·13	4·11	2·44	2·19	17·10

This is as might be expected, for the rain-clouds from the Atlantic borne to us and to other stations on the east coast of Ireland by the prevailing westerly and southerly winds are deprived of much of their moisture before they reach us by contact with the high land over which they pass, whereas at stations situated about the south-westerly extremity of England the rain-clouds are there first tapped by the land, and discharge a great deal of their rain on the spot.

I think I have now shown that the climatic conditions under which we live at Kingstown are favourable to health, and the comparison of mean temperature, range of temperature, and

annual rainfall at Dublin, of which I can find a record, was that of 1846, amounting to 36·11 inches. See paper on the Meteorology of Ireland, by Rev. H. Lloyd. Transactions of the Royal Irish Academy, Vol. XXII., p. 472.

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rainfall, in Tables II., IV., V., and IX. shows its superiority in these respects to some of the most favoured English health resorts.

As regards soil, the site upon which Kingstown is built is usually stated to be granitic, which, according to the best authorities, is most favourable to health. It is to be observed however, that though the site of Kingstown is granitic, geologically speaking, a large part of the town is built upon an alluvial deposit, in some places attaining a depth of fifty feet, occupying an extensive depression in the granite, extending from Wellington Street westward as far as Monkstown Church, and from the sea inland as far as Monkstown Avenue. The escarpment of this formation may be seen behind the gas-works at Dunleary. Some of the worst slums of Kingstown are built on this site, including a locality rejoicing in the characteristic name of "Pig-bank." The deposit consists mainly of limestone gravel, a soil most favourable to health; but until recent improvements in the sewerage of the township, this region was traversed by two rivulets laden with sewerage matters, known as Sallynoggen and Stradbrook streams. These form a junction in the immediate neighbourhood of Juggy's Well, a water-source much affected by the lower classes of Kingstown on account of its supposed purity. I find, on reference to a map, prepared by Mr. Andrew Pallas, C.E., upon which he noted the cases of cholera occurring during the epidemic of 1866, that 50 per cent. of all the cases in the township occurred in this limited area.* Since then the sewerage of this district and of all Kingstown has been vastly improved. The Vartry water-supply of Kingstown is admirable. Thus all the physical conditions are favourable, the climate, soil, water-supply, and sewerage being good. The unsatisfactory state of our vital statistics must, therefore, be due to some shortcomings in the social or economic conditions of the township. On proceeding to examine the township with some care, the first thing that struck me was the number and wretchedness of what I may call the slums—miserable courts and rows of wretched hovels, in which a healthy or even decent life is well-nigh impossible. These are, for the most part, hidden from view by dwellings of a more respectable character, being, in many cases, erected in what were formerly the yards or gardens belonging to the houses which conceal them, so that all seems prosperous enough to the casual observer. The number of such hovels and of their inhabitants indicates a proletariate out of all proportion to the possibility of employment in such a town. I have ob-

* I have to thank Mr. Doyle, our present town-surveyor, for lending me this map and giving me valuable information as to the extent of this gravel deposit.

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tained from our sub-sanitary officer a return giving particulars as to these dwellings and their inhabitants in Kingstown, and, through the kindness of Mr. Drury, similar ones for the neighbouring township of Rathmines, all of which I have thrown into a tabular form.

TABLE X.—*Particulars as to Cabins, Tenement-houses and their inhabitants in the Kingstown and Rathmines Townships.*

KINGSTOWN.

Class.	Total No. of houses of each Class.	No. of houses of each Class unoccupied.	No. of houses of each Class occupied.	Total No. of rooms in each Class occupied.	Total No. of inhabitants in each Class.	Average No. of inhabitants per room.	Remarks.
A	437	65	372	372	1178	3·17	Class A, houses of one room each, under £2 valuation.
B	754	58	696	1392	2734	1·96	Class B, houses of two rooms each, under £3 valuation.
C	234	Rooms 84	234	988	2130	1·86	Class C, houses of more than two rooms let in tenements.*
Totals	1427	123	1304	2756	6042	2·33	

RATHMINES.

A	45	Class not given in Returns.	45	45	153	3·40	Class A, houses of one room each.
B	215		215	430	981	2·30	Class B, houses of two rooms each.†
C	285		285	1188	2328	1·95	Class C, houses of more than two rooms let in tenements.
Totals	553	8	545	1663	3462	2·55	

From this table it will be seen that the population inhabiting these dwellings in Kingstown amounts to 6,042, out of an entire population of 19,628 (census, 1881)—roughly speaking, one-third, whereas Rathmines, with a total population of 24,245, has only 3,462 inhabiting such dwellings, amounting only to one-seventh. Such a number of persons in Kingstown con-

* There are fortunately only about 60 tenement houses in Kingstown. They are mostly small, none being more than two stories high, generally without a basement.

† The Rathmines valuations have not been obtained. I am informed that some of the two-room cottages are of a superior class, valuation as high as £10.

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stantly on the verge of pauperism is, I believe, completely abnormal even in Ireland, and makes our township extremely sensitive to the influence of "bad years." The year 1881 strikingly illustrates this. The number of persons from Kingstown relieved at the Rathdown Union in 1880 was 796, while in 1881 it rose to 1,743, the reason being that owing to agrarian trouble, agricultural distress, and consequent financial depression, the number of visitors to Kingstown was greatly lessened. This is shown by the fact that the number of unoccupied houses valued at £20 and upwards was 100 in 1880, while it rose to 115 in 1881, and continued to increase until it amounted to 160 in 1883. In the better circumstanced township of Rathmines this depression was scarcely noticeable; the number of persons from Rathmines relieved in the South Dublin Union in 1880 was 266, while in 1881 it rose only to 290, showing a very small increase. The number of these wretched dwellings and of their inhabitants in Kingstown is easily accounted for by a glance at the history of the township. Kingstown, though now affording little employment, was once a place of busy industry. In 1816 Dunleary was a little fishing village, when the harbour now called Kingstown Harbour was commenced—a vast work which gave employment for many a year to a great number of men. In 1834 the Kingstown Railway—the second line constructed in the United Kingdom—was opened, and the town entered on a career of rapid expansion. The Atmospheric Railway to Dalkey was opened in 1843, and the town continued to increase in size rapidly up to 1871. From 1871 to 1880 the increase seems to have been very slow, and from the latter date it has been on the decline, as I intend to show. During all these years Kingstown was a busy place, affording constant employment to an army of artisans and labourers, to accommodate whom the cabins of which I have been speaking were originally built. Kingstown is not now a place in which any large number of persons can find employment. The small fishing industry it once possessed is nearly extinct. Almost the sole occupation the town affords is jobbing, casual employment in connection with the maintenance and repair of the houses of the well-to-do, eked out by assistance from charitable societies and public relief; this, with the more miserable resource of begging, supports most of the inhabitants of these wretched dwellings. On the completion of the harbour, about 1860, some of the unemployed must have left the township, for I find by the Registrar-General's Returns that in the decade 1861-71, the increase in the number of inhabited houses was 405, while the increase in the population during the same period was only 360. The 405 new houses being of a superior class, occupied by

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families which we cannot estimate at a lower average than five persons each, indicates an increase of the well-to-do population vastly in excess of the increase in the entire population, which is only 360, showing a corresponding decrease in the working classes. Thus Kingstown presents some of the worst features of a town of decaying industry, crumbling hovels, and an undue proportion of perhaps the most helpless class in the community, worn-out workmen, too old to seek employment elsewhere, and clinging to the spot which once afforded them the means of comfortable existence. To these conditions we owe our low birth-rate, relatively high death-rate, and large admission into the Union Workhouse. These conditions have, I believe, continued more or less for the last fourteen or fifteen years, the ill growing with terrible rapidity since the troubles of 1881. This is shown by the increase in the number of unoccupied houses of the better class as already mentioned. This falling off and the consequent want of employment was followed by an increase in the number of unoccupied cabins, which in 1882 was only 20, while at present it amounts to 123, as shown by Table X. This increase in the number of unoccupied houses points conclusively to a corresponding falling off in the population. Moreover, I find on reference to the Registrar-General's Returns that the number of births registered within the township decreased from 463 in 1880 to 401 in 1882, representing a decrease of 13 per cent. in the breeding population, which, when taken with a corresponding decreased number of deaths, proves, in my opinion, a considerable falling off in the entire population. At first I believed that improved sanitation, and especially improvement in the dwellings of the poor, would remedy all the ills existing in our township; but further examination has convinced me that these measures, however desirable in themselves, cannot be expected to effect a cure of the disease which is chronic, and I almost fear hopeless—poverty.

On "The Insanitary State of Small Irish Towns," by J. WYCLIFFE-JONES, Surgeon-Major in Medical Charge of H.M.'s Troops at Naas.

The deplorably insanitary condition of several small Irish country towns, in which, during various periods of my service at home it has been my lot to be stationed in medical charge of H.M.'s Troops, has impressed me so forcibly that I feel

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moved to submit a brief paper upon the subject to the Congress.

The importance of the subject would merit far wider treatment than I can give to it. But the fact that the statistics available deal with the sickness and mortality of small towns, only as they form a part of a large rural district, precludes the possibility of fixing the amount of sickness and mortality chargeable to the town itself, apart from its surrounding rural district.

I feel strongly convinced that the death-rate must be high in many towns I have known; yet upon an examination of the statistics of the area into which such towns were collated I have been astonished to discover a very low rate of sickness and death.

This statistical imperfection has a further important bearing: I cannot, in justice, condemn the condition of things in any one town as exceeding, in evil case, those of any other; for, again, I am unable to prove my case. For instance, although the insanitary state of Naas, my present station, is so bad, so deplorably bad, that in certain portions of the town every essential for healthy life is absent, I cannot state from personal observation, nor can I prove by figures that its condition is in any degree worse than that of many other towns I have formerly resided in. I must therefore be content to furnish a brief epitome of the results of several years' observations:—dividing these under the several heads of

(1.) Overcrowding.
(2.) Particular descriptions of dwellings, and rent.
(3.) Sewerage and conservancy.
(4.) Water supply.
(5.) Ablution.
(6.) General habits and state of the people, and intemperance.

Overcrowding.—A traveller on foot, approaching an Irish country town, who, forsaking the high road, takes the field-paths, will be much struck by the numerous little groups of workmen who meet or overtake him, as the case may be, all wending their weary way towards the one goal—the town: these are farm labourers who have walked out two to four miles to their work in the early morn, and are now—having neither lot nor part in the land upon which they have expended a day's toil—plodding their way home: to what kind of a home we shall see anon.

A time there was, as I am informed, when these men, their wives and children, resided in the country, surrounded by a bright atmosphere of rural industry and humble plenty. This

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no longer obtains, and so rural families who have not emigrated, are compelled to seek shelter in the nearest town; in which they are shamefully ill-lodged, and where they, too often, must submit to extortion. And further, where, from the want of employment, idle and many vicious habits are quickly learned.

Adhering to my text, Overcrowding, I will supply a few salient facts. In a most wretched, half-ruinous, two-storied house, containing four simply shocking rooms, I found four families resident—in all, twenty-two souls. My visit—made for the dispensary physician, absent on leave—had for its object the relief of a poor woman in her confinement; and this took place in one of the smallest and worst rooms in this terrible abode, and under such circumstances of appalling squalor and deficiency as made her subsequent recovery a matter of astonishment to me. Another instance: to everyone who has any knowledge of Ireland, the form of the Irish cabin will be familiar; the outer room, or kitchen, and the inner room—"the room" *par excellence;* both floors are clay usually, and the levels lower than that of the street. In winter damp prevails, but one fire-place is provided, and this utterly devoid of any description of grate. Let us, then, imagine two to three families huddled together upon the two floors.

Other instances will be interpolated between particular descriptions of dwellings, as an essential to that division of the subject, but I am convinced that extreme and cruel overcrowding is a wide-spread sin of Irish country towns.

Particular Descriptions of Dwellings.—I almost despair of being able to convey even a faint idea of an Irish country-town dwelling to those of my hearers who belong to the eastern shore of the Irish sea. Accustomed as they are to the bright red-tiled kitchen floors, the oven-and-boiler range, the clean boarded bed-room floors—of the English workman's home; I scarcely expect credence from them for the following descriptions: but my Irish hearers will, without difficulty, supply parallels to every instance I submit.

The Irish dwelling is of two classes: the one-storied clay-floored cabin—I cannot with truth use the cheerful English word "cottage" very often in Ireland, cottages are far too scarce—and the two or more storied house.

Now I wish to state at once that I believe that these latter will be usually found to furnish instances of a lower degree of insanitation than even the cabin—vile though it be—and this seems partly to be the result of a belief in the unlimited capacity of any dwelling that possesses several floors. Even though the ground floor be rather crowded by the wretched "deputy sub-assistant landlord," his family and guests, there is

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always "*plinty* of room up-stairs," or rather, "above in the rooms"—"above" conveying to the Irish imagination an almost unlimited degree of storied elevation, provided that the two, four, or sixpence per night be forthcoming. Again, too, the police cannot so easily penetrate, nor can the members of that stalwart corps feel very safe upon the crazy stairs.

The worst descriptions of dwellings are usually to be found hid away in lanes and courts behind the main streets.

I will endeavour to describe a small court of dwellings very recently visited. The entrance is in a narrow lane of cabins, and this opens to the main street of the town. Picture then a horrible little courtyard some 50 ft. × 28 ft. almost completely enclosed by small dwellings; the ashpits, pigstyes, and back yards of the front row of hovels forming the only prospect possible for those inside the court. The entire block of building does not occupy, to the best of my judgment, nearly one rood of land, nay, indeed, not one-sixth of an acre. Upon this site are built thirteen simply frightful dens, all have damp or clay floors; pools of green and black water lie all around, black typhoid mud, and festering manure in abundance. Some fifty-five to sixty souls live in this court, and many pigs are kept. I measured several houses, and append a few results. No. 1 house, 5·7 × 14·2 × 6·9 = cubic ft. less than 588; four souls live here. No. 2, 15·7 × 12 × 9·6 = cubic ft. less than 1,800; five souls resident. No. 3, 15·7 × 10·8 × 9·6 = cubic ft. less than 1,500, and eight souls resident. In the first about 100 cubic ft. of foul damp air could be enjoyed, in the second about 300, if no lodgers come for the night, in the third about 142. For the worst description of dwelling 1s. to 1s. 6d. per week is paid, but 2s. 6d., 2s. 8d., and 3s. is very commonly demanded even for cabins, which can, with truth, be described as "unfit for human habitation." A very wide field of observation, both in Europe and in India, has not furnished me with any parallel to all this. In no country on the globe has human misery reached so low a degree of degradation. Picture what life must be in such dwellings, and be well assured that I furnish no isolated instance, but a true representation of what is all but universal in Irish country towns.

The worst dwellings are to be found in towns owned by a number of small proprietors. In these, sub-letting of even fairly good houses is carried to a ludicrous degree. A bachelor friend of mine once obtained, with difficulty, in a small country town, two furnished rooms in the same house; but he rented his sitting-room from one landlord, and his bedroom from another. Again, in the instance mentioned of the house in which I found twenty-two souls, two or three landlords were part owners, and

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the third, who occupied one room—*i.e.*, himself and family—drew 8s. 6d. per week from three sets of squalid lodgers. The house pays to various owners about £34 a year, when quite full. I would be sorry to give that sum for the materials of which it is built.

Sewerage and System of Conservancy.—My experience leads me to the strong belief that under this head every sanitary rule is almost universally violated. Having regard to the towns at large I am unable to remember one where an efficient system of drainage and sewerage exists.

Latrines, &c.—Then, as to latrine accommodation, it is notorious that none whatever is provided for a very large number of the humbler dwellings in Irish towns; while even houses of a better class are vilely provided. The state of deplorable degradation engendered cannot be exaggerated. Connected with this subject I must speak of the intense nuisance created in the horrible labyrinth of back yards seldom absent in Ireland. Here pigs and horses are kept; often, too, no back-lane entrance exists, and at potato sowing time I have often seen two or three cart-loads of festering black typhoid sludge and manure conveyed through, not one or two, but *many* dwellings, and thrown in a large heap upon the main street, until carted away; the unspeakable stench at the back, inside, and in front of the house may be imagined.

I would say a word about slaughter-houses, and shall describe one. In a minute yard, entirely hemmed in by buildings, whose back windows open upon it, hundreds of sheep and cattle have during many years been slaughtered; no back lane gate exists, the beasts are driven in to their death through the street door. A slight whiff from this fearful den has sufficed to produce in myself severe nausea. This is a fair sample, for all I have seen are very similar.

Water supply and means of ablution. The source is usually pump wells, and the quality is not prominently bad, but the quantity is often scanty, and always insufficient, for those living far from a pump, hand-carriage being the rule, a cruel labour generally imposed upon the young.

The means of ablution are of the humblest, dirty water is thrown into the kennels, and what with overcrowding and clay floors, extreme personal uncleanliness prevails.

Habits of the people and intemperance. With such surroundings no one will marvel to hear that excessive drinking is too often practised in Irish towns, by those housed as described; indeed, poverty or want of credit are the only checks to this vice, and it is so notorious and deplorable as to need no further notice.

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I fear being an undue trespasser upon your notice and time, and I therefore conclude with an earnest desire that a root and branch reform may, ere long, be applied to this wide-spread and destructive evil.

Sir ROBERT RAWLINSON, C.B. (President of the Congress), said the condition of these towns, bad as it seemed to be, could have been paralleled some years ago in parts of England and Scotland, and in some cases it was not very much better even now. To remedy this state of things money must be expended, and there should be local regulations to prevent overcrowding. The progress of modern sanitary improvement took merchants and the better class tradesmen into the country, and the houses they left degenerated into tenement-houses, for which they were not fitted; but they were divided and sub-divided, the windows got broken, there was no privy accommodation, no water-supply, and all other sanitary arrangements were defective. An artisan from the country, with probably a good constitution, accompanied by his pure-minded wife and two young children, found himself obliged to live in one of these places, where he soon perished from fever, the wife and children were relieved by the parish; but the poor wife, while still young, gradually degenerated into the lowest habits. All these evils resulted from the want of proper house accommodation, and they in England had no desire to make out that those in Ireland were worse than other people.

Dr. ALFRED CARPENTER (Croydon) said the Association had thought the question of the housing of the poor was a very proper one to be brought before this Congress. He had heard the paper read with some degree of pain, because it described a state of affairs which was absolutely unnatural. He was almost afraid to say to an Irish audience all that he felt upon a paper of the kind, because it was so difficult to avoid touching upon questions connected with the land and the duties of its owners towards the people; but he could not help saying that any landlord who allowed his cottages to remain in such a condition as that described was failing in his duty to himself, his family, and to the nation at large. The mischief which arose from such a state of things eventually struck home to the landlord to a dead certainty. The establishment of the owner or some other of the large residences near to, or it might be at a distance from such a neighbourhood, were sooner or later struck by a shaft from one of these cabins, perhaps the nearest and dearest might be carried off by some disease the germs of which had been generated in wretched dwellings of this class. Providence visited such neglect upon the responsible parties either in loss of health, of that which was dearer, or of life itself.

Surgeon-Major HAMILTON (Dublin) described the sad condition of

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certain places at which lived the families of soldiers *married without leave*, and mentioned a case of overcrowding near Portobello Barracks, in which a man, his wife, and seven children lived in one small damp room; though, he added, that matters had greatly improved since he entered the service some years before.

Mr. BRUEN (Carlow) said that no doubt such things as were described in the paper were to be found in some Irish towns, but it was going too far to say that this condition of the houses was all but universal. In the towns of which he had knowledge it would be difficult to pick out such cases as had been described. How was such a state of things to be ameliorated? Parliament had made provision to enable owners to borrow money to erect labourers' cottages, but the provisions of the Act were only applicable to country parts, and he suggested that they should be extended to the towns.

Dr. T. W. GRIMSHAW, President of the Section (Registrar-General Ireland), agreed with Mr. Bruen that there were many places where the state of things described did not exist; but on the other hand, there were many places where it did prevail, especially in small towns. Mud cabins were to be found in some parts of the North of Ireland. But he believed that in Ireland generally they were improving.

Surgeon-Major J. WYCLIFFE JONES (Naas), in reply, said that as far as his experience went those towns where the landlord was the direct owner were the best from a sanitary point of view; and those towns where the titles were complex, where there were a number of owners, or where the houses were sub-let, furnished the worst examples.

On "The Sanitary Conditions under which Cholera prevails in Northern India," by Surgeon-General A. C. C. DE RENZY, C.B., of the Indian Army.

At the present time when cholera is causing great loss of life on the Continent, I hope that a short account of the sanitary conditions under which the disease prevails on its native soil in India may not be without interest and practical value in this country.

A few figures will show what terrible ravages the disease commits in India. Among the native population in 1882 there were 351,971 deaths *registered* under the head of cholera, and this figure, enormous as it is, very much understates the fact, because a vast number of deaths altogether escape registration owing to the unavoidable imperfection of the machinery employed for the purpose. We have more accurate records of the

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cholera mortality among the British troops. In the 21 years ending with 1882, in the British garrisons of Northern India, averaging a strength of 36,744 men, cholera caused 3,802 deaths, or 103 per 1,000 of strength. Or to take a shorter period for illustration, and excluding the deaths that occurred among the troops in the Afghan war, in the five years ending with 1882, the British troops had 725 deaths from cholera, or 21·6 per 1,000 of strength. Supposing the same rate of mortality to have prevailed in Ireland in the same period, there would have been 108,000 deaths from cholera.

In order to convey a clear conception of the sanitary conditions under which cholera prevails in Northern India, I shall briefly describe the state of a few well-known places that may be regarded as typical of the whole. I shall take Mianmír as the type of military stations. This station was selected in 1849 by Sir Charles Napier under the best medical advice then available. It is six miles from Lahore and seven from the river Raví, above which it has an elevation of 50 feet.

It stands on a great alluvial plain, 1,000 feet above the level of the sea, and is so dry that the surface is perfectly destitute of vegetation. The street surfaces of this city are not more bare of vegetation than the surface of the Mianmír Plateau in its natural state. Of late years, with the aid of artificial irrigation, trees have been grown in the cantonment, but they present a stunted, unhealthy appearance except where they are plentifully supplied with water. The soil is a stiff clay, very impenetrable to water. The rainfall is about 20 in. in the year. The mean temperature in the shade ranges from 98° F. in June, to 52° F. in January, and the mean humidity of the air from 20 in May to 58 in September — the mean of the whole year being 40. Saturation being = 100.

Water is found in abundance at a depth of 40 ft. The strata lying between the surface and the water level are extraordinarily free from moisture. A sample taken at a depth of 6 ft. was found on analysis to contain only 11 °/₀ of moisture.

The cantonment occupies an area of 10 square miles, the garrison consisting of about 3,000 men, of whom 1,000 are Europeans, the rest native troops. The whole population, including the population of the bazaars, camp followers, &c., was at the census of 1868 13,757, or about 5 persons to the acre. The features which, independently of military considerations, commended this site to Sir Charles Napier, were its great dryness and the facilities it affords for the rapid discharge of the rainfall.

The health history of the station is truly tragical. Typhoid fever has always prevailed, and in 1856, 1861, 1862, 1867,

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1872, 1879, 1880, and 1881, the troops suffered severely from cholera. In 1856, 31 °/₀ of the European troops were attacked, and 16 °/₀ died. In 1861, 42 °/₀ were attacked, and 24 °/₀ died. In the later epidemics the mortality did not exceed 8 °/₀.

Now what were the sanitary conditions under which these disastrous epidemics occurred? The troops were well housed, and had plenty of room. The barracks were designed by Sir Charles Napier himself, and quite regardless of expense. They were spread over a very wide surface in order to avoid the evil of overcrowding. The scavenging was fairly good—that is, so far as surface inspection went there was very little filth to be seen. There were no sewers of any sort; the roadside drains were intended for the discharge of rainfall only.

During the first two epidemics there were two most grave defects. (1.) The privies were trenches which were originally fifty feet deep. In these the night soil accumulated from year to year, so that at last they were filled up to within twenty feet of the surface, and the stench from them was, at times, perfectly overpowering. The privies were at a distance of 100 yards or so from the barracks. The second defect was closely connected with the first, for, unfortunately, the wells—one for each company barrack, which supplied all the water required for every purpose—were only 100 yards from the privies, and, of course, they became contaminated with excremental matter, which readily percolated through the sandy water-bearing sub-strata. It was only when the terrible outbreak of 1861 occurred that the danger of this state of things attracted attention, and then the trenches were ordered to be cleaned out, and privies to be formed on the surface dry earth system. Immense quantities of fœcal matter were removed, but, no doubt, much of the deposits of previous years had passed beyond reach of removal.

The wells continued to be used as before. In the following year there was another great epidemic, when 5 °/₀ of the British troops were destroyed. The construction of the wells was peculiarly bad. The following description of them is taken from the Punjab Sanitary Report of 1868:—"Attached to most of the wells is a masonry reservoir, eight feet square by four feet deep, and elevated about six feet above the ground level. These reservoirs were covered with planks loosely laid. Some of the planks had been removed from the reservoirs that I examined, leaving spaces a foot or two wide uncovered. I saw a good deal of dirt of different kinds in the reservoirs. Wells are a favourite place of rendezvous for natives, and the covers of the reservoirs afford a comfortable seat. But, besides the large reservoirs, there were smaller ones, about two feet square. Water is re-

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ceived from the large reservoirs into the smaller through an iron pipe. The smaller reservoirs are quite uncovered, and from these the bhistis (water-carriers) fill their water-bags (mussacks), squatting, during the operation, on the side-wall of the reservoir, their shoes often in actual contact with the water. These small receptacles are freely open to any one who wants to draw water, the sweepers of the adjoining privies included. It is impossible to say, at this time, to what uses the water in the receptacles may not have been applied." I have little doubt it was constantly used for rinsing out the latrine utensils.

By 1872, when the next great epidemic took place, an important change had been made in the water supply, for an irrigation cut, a branch of the Baré Doáb Canal had been led into the station and *the drinking water* of the troops was ordered to be taken from it. This cut, which was about three feet wide, flowed through the station uncovered, and water was conveyed from it in the usual way by bhistis with mussacks. Some time *before* the epidemic broke out among the troops, cholera had prevailed among the native population, and some days *after* the occurrence of the outbreak the body of a native was found lying in the cut, above the point where the supply of the troops was taken. It was, most probably, the body of some poor wretch who had gone into the cut to relieve the agony of the thirst of cholera.

Briefly, in the later epidemics, at all events, the sanitary condition of Mianmír may be described thus. The scavenging was as near perfection as possible, there were no sewers of any kind. All excreta liquid and solid were removed in carts. The latrines were kept so sweet on the dry earth system, that there was a complete absence of offensive odour. The troops had good food, suitable clothing, light duties, splendid barracks, with abundant ventilation; the one defect was the water supply, it was open to contamination in a great variety of ways. Whenever cholera prevailed in the neighbourhood, its infection had the most ample facilities for reaching the water supply, and it is specially worthy of note, that in no single instance has cholera broken out at Mianmír until after the neighbouring population has been attacked.

The description of the sanitary state of Mianmír applies, with slight modification, to all the stations in the plains of Northern India. The scavenging is good in all. I have never seen any English town so cleanly kept as the Punjab cantonments. The barrack accommodation too is magnificent. The Government have spent upwards of twelve millions sterling within the last eighteen years on barrack accommodation. But the water supply is everywhere bad. This is the fatal flaw in

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the sanitary arrangements, the removal of which will, I believe, render the cantonments of Northern India quite as healthy as any part of these islands. In Fort William, in Calcutta, where the old barbarous methods of water supply were abandoned twelve years ago, the death-rate of the troops which used to be upwards of 10 per cent. per annum has in the ten years ending in 1882 been only 9 per 1,000.

With regard to the native population it would be impossible within the limits of a paper suitable for an occasion like this to give an adequate idea of the foulness of native towns. Within the last few years endeavours have been made to remove from them the grosser and more tangible forms of filth, but, limiting my remarks to the Punjab, with which province I have the most intimate acquaintance, I do not know a single town in which, in the more retired parts, there is not an overpowering stench, more especially in the rainy season. The Punjab is a great alluvial plain, as flat as a bowling green, and the houses in the towns are packed together as close as they can stand. The streets are so narrow that, as a rule, two carts cannot pass in them, and in many parts they are so narrow that wheeled conveyance is altogether impossible. There is no sewerage whatever; merely surface saucer-drains, which carry certain proportion of the semi-liquid filth to a hole, formed within the town limits by the removal of earth for making the bricks, with which the houses are built. The water supply is taken from wells sunk in the excrement sodden soil, often within a few feet of the hole into which the saucer-drains discharge. Need I say that this water is altogether unfit for use. I have chemically tested the water of hundreds of Punjab towns, and I cannot recall a single instance in which an English health officer would pronounce the water fit for use. The water taken from wells within the polluted town area differs entirely from that taken from wells situated in clean unoccupied ground outside the town limits. Thus, to take a specific case, at Umritzur, outside the city wall, the well waters contain about two grains of chlorides per gallon, while within the city the amount estimated as common salt was found to range from 4 to 189 grains per gallon, from 10 to 15 grains per gallon being the usual amount. It is obvious that the excess of chlorides must have been derived from animal excreta. Such is the sanitary condition of the Punjab, which is a comparatively healthy province, and may be made one of the healthiest places in the world. In Bengal and Assam, the endemic home of cholera, things are much worse. In these provinces there is the same surface filthiness, but the water supply is far worse than it is in the Punjab. It is derived from open tanks, which are often filled by the drainage of localities

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of indescribable filthiness; and the tanks are used for bathing and clothes-washing, as well as for the supply of drinking-water. In the Punjab wells the water undergoes a certain amount of filtration in passing through the strata lying between the foul surface and the sewage holes; but in Bengal and Assam the tank waters are frequently unadulterated unmitigated sewage. It is only the rapid growth of vegetation in these tanks that saves the population who resort to them from destruction.

The history of cholera in the great cities of Calcutta and Bombay is full of encouragement as to the possibility of preventing cholera, and of instruction as to the means required for that purpose. In former days the European residents used to suffer very severely from the disease in both cities. It was a very common occurrence when I first went to Calcutta to dine with a friend one evening, and to hear next morning that he had died of cholera. This state of things has ceased, and the European residents in both cities have now as low a death-rate as the West End of London. How has this change come about? In Calcutta it was the immediate effect of the introduction of a good supply of water, combined with the sewering of the European portion of the city, and the proof that this is the case, is the fact that in the native portion of the town to which these improvements have not extended cholera is as bad as ever it was. In 1882 there were 2,240 deaths registered in Calcutta, and of these at least three-fourths took place in the northern division of the town, where there are no sewers, where the sewage putrifies in roads or ditches, and where the water supply is derived from polluted tanks. Even on the south side the natives bathe in tens of thousands in a nulla, in which the water is very foul sewage.

Bombay teaches the same lesson. This city has a population of 800,000 inhabitants. Formerly it was scourged every year with cholera, the deaths from the disease numbering from 2 to 5,000 in a much smaller population than exists at present. In 1865 that wise statesman, the late lamented Sir Bartle Frere, succeeded, after a difficult encounter with native prejudice, in bringing in a pure supply of water, and from that year to the present cholera can hardly be regarded as having been epidemic in the city, except in the great famine years 1877 and 1878, when thousands of starving cholera-stricken people crowded in from the adjoining districts. In 1882 the cholera deaths numbered only 190. In 1876, although there were 32,000 cholera deaths registered in the adjacent districts, there were only 374 deaths from the disease in Bombay city.

The influence of a pure water supply is particularly noticeable in the case of Bombay, because the sewerage of the city is

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really in a terrible state. The sewers are rough flat-bottomed conduits, often with little or no fall. Scores of miles of sewers have to be opened out every year in order to remove the lodgments that form in them, and the stenches that these deposits emit into the streets is simply overpowering; but, in spite of this, ever since the introduction of a good water supply nineteen years ago, deaths from cholera have been exceedingly rare among the European inhabitants.

The work of sanitary improvement in India is beset with great difficulties, owing to the strange prejudices of the native population with regard to water. An idea of the strength of this prejudice may be formed from the fact that even now, after eighteen years, there are people in Bombay who would rather die than touch the pipe water, and the same feeling prevails, though to a lesser extent, in Lahore, and other cities. But experience shows that this prejudice, if treated with judgment and consideration, gradually dies out. In Bombay, at first, there were many thousands of people affected with it. Now there are only a few hundreds.

It is to be hoped that the British Government will now take up the question of sanitary improvement in India with resolution and earnestness, and at all events make it impossible for cholera to propagate itself in the great seaport towns. This is a duty which it owes to the civilised world now that the opening of the Suez Canal has so greatly facilitated the spread of cholera from India to Europe.

And here I would briefly call attention to one source of cholera infection which is very apt to escape notice. I refer to Mecca, the great Arabian place of Mussalman pilgrimage. The reduction of the cost of pilgrimage of late years has enormously increased the number of pilgrims from India, and remembering this, it is not surprising that there have of late been several great outbreaks of cholera at Mecca. There was one there in the spring of 1883, which caused immense mortality, and excited very little attention in Europe, owing to the rigorous precautions that are taken to prevent the defilement of the sacred place by the presence of the infidel. This is a matter which deserves the serious attention of the States of Europe, as Mussalman pilgrims would be very apt media for the conveyance of cholera to Egypt and the southern shores of the Mediterranean. I have a very strong suspicion that it was through the pilgrims that Egypt was infected last year.

In conclusion, I submit that the experience of cholera in India affords sure grounds for believing that cholera is a disease which, more perhaps than any other of the great pestilences which afflict the human race, admits of prevention.

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Places in which the soil is kept pure, and where the water-supply is taken from a pure source, and is so distributed as to be incapable of receiving contamination in transit to the consumer, have little to fear from cholera. It is only places where the soil is allowed to become saturated with excrement, and where the water-supply is taken from wells situated in an excrement sodden soil; or if it be taken from a pure source, where it is allowed to become contaminated in foul cisterns, or by sewer air through the channel of pipes connecting the water mains with the sewers, that have reason to dread it. In places where such conditions exist cholera is justly an object of terror.

Surgeon-Major HAMILTON (Dublin), who had had eighteen years experience as an army surgeon in India, differed from some of the conclusions arrived at by the author of the paper. He was inclined to concur with the views of Dr. Bryden, who expressed in many of his magnificent works, which were now historical, his theory of cholera. Dr. Bryden held that there was an endemic area of cholera, which was the delta of the Ganges; in this enormous district cholera was always present. His argument was that the south-east monsoon spread cholera from that area throughout Upper India. It had been found that cholera did not attack the whole of Northern India at once. Its progress was distinctly traceable, and might be traced overflowing the endemic area. It would advance northward during the summer, gradually die down during the autumn, and disappear in the winter. Sporadic cases might occur in a district during winter; and this, Dr. Bryden holds, meant the invasion of that district, and if meteorology were favourable an outbreak would occur in that district the following spring. He contested Surgeon De Renzy's theory that the cholera was caused by impure water. What possible connection could there be between an epidemic of the character which overtook the British Army in Northern India, in 1879, and impure water? When cholera was epidemic impure water would no doubt increase and intensify it. Surgeon De Renzy had spoken of the unsanitary character of India. It was undoubtedly terrible in many ways; in fact there was no such thing as sanitation among the native population in India. But he did not think Surgeon De Renzy was quite fair in taking Mianmir as a type of the Indian military stations. Cholera in the Bengal Presidency invariably advanced northwards. It never radiated from a centre. There was not an instance of record of cholera going down stream in the valley of the Ganges. He disputed the argument that cholera was distributed by human intercourse. He had no doubt a great body of men marching through a district prepared for cholera would act as a spark to gunpowder. But to say that an individual passing from here to there could carry cholera in his clothes into a district not prepared for cholera, was to say what he believed to be

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undoubtedly wrong. It had been clearly proved that cholera "in India at all events," was not contagious, in the ordinary sense, although Dr. Bryden admits that when it invaded Europe, it did seem to take on the typhus form. He firmly believed that so long as the face of nature in India remained unchanged, so long would there be great periodic outbreaks of cholera passing from Bengal to the north of India, through the Khyber Pass and Central Asia, and from thence invading Europe, which was the way, he believed, the present outbreak invaded Europe.

Dr. W. J. Simpson (Aberdeen) could hardly agree with the previous speaker. He had no experience of India; but he was at Damietta last year during the outbreak of cholera in Egypt, and what he observed there would induce him to support the theory of Surgeon De Renzy, that impure water supply was the cause of the spread of the disease. The cholera had been in Damietta long before official reports mentioned it, and it was only when the Nile had reached its lowest point and had become thoroughly contaminated with the discharges from several cholera patients that the outbreak assumed its epidemic form.

Surgeon-Major Wycliffe Jones (Naas) believed that the theory that human intercourse would *not* propagate cholera had been disproved by the great European outbreaks, and that the doctrine would be a highly dangerous one. In 1865 cholera spread all over the Mediterranean basin, and it was observed to pass by certain places, and to attack others more distant from the delta of the Nile and the port of Alexandria. This outbreak probably originated at Mecca, and was carried thence by pilgrims returning home; the places thus escaping were proved to be those that received few or no returning pilgrims, and to have, generally, little or no intercourse with the point of origin. In 1867 cholera was clearly conveyed all over India, *in a southerly* as well as every other direction, by pilgrims from Hurdwar.

Dr. J. F. J. Sykes (Hon. Sec. of the Section) reminded Surgeon-Major Hamilton that in the present epidemic in France they had an example of cholera travelling *southwards* into Italy.

Surgeon-General De Renzy, C.B. (Bray), then replied. With reference to Surgeon-Major Hamilton's enquiry as to what possible connexion there could be between the cholera epidemic that attacked the British troops in Northern India in 1879 and impure water, Surgeon-General De Renzy saw a very close connexion. Owing to the primitive and defective state of the arrangements, the water supply of the troops was open to contamination in a hundred ways, and when cholera prevailed among the native population, it was simply owing to good luck that its contagium did not reach the troops through the medium of their water supply. He described the arrangements for the supply of water to the troops on the Afghan campaign. An open metal bucket was fastened to the tent pole. The drinking

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water was emptied into the bucket from the goat skin (Mussak) in which it was conveyed, and the men ladled the water out of the bucket as they required it with a panikin. The atmosphere of the tent was thick with dust, which was being constantly deposited in the bucket. He had seen a sick man vomiting in a tent on the ground—the vomit soon dried up, and was dispersed through the air as dust. Is it to be wondered at that in such a state of things when cholera appeared in the vicinity, it soon extended to the troops and committed terrible ravages among them. With a well-arranged water supply, he believed that the troops in Northern India would be as healthy as those quartered in the United Kingdom. Dr. Hamilton was quite mistaken in supposing that cholera epidemics invariably travelled northwards. It is wonderful with what persistency this erroneous statement clings to life. The fact is, that a year hardly passes that cholera does not spread from its endemic area in Bengal towards Jubbulpoor and the southern tracts of India.

On "The Objects and Work of Ladies' Sanitary Associations," by SARAH ELIZABETH GRIMSHAW. *Read by* R. O'B. Furlong, Esq., M.A.

AT the meeting of the National Association for the Promotion of Science, held in Dublin in 1881, a paper was read by Dr. T. W. Grimshaw, entitled, "The necessity for extending the operations of Ladies' Sanitary Associations."* At that time the Dublin Ladies' Sanitary Association had been but six months in existence, its aims and plans were brought under the notice of the Health Section, and Dublin ladies obtained (by means of the paper referred to and the discussion which followed its reading) many useful hints and much valuable information as to what the scope and duties of such associations should be. At the meeting of this association, which is altogether devoted to the promotion of measures connected with the health of the people, it is a pleasing duty to announce that the Dublin Ladies' Sanitary Association, although still struggling, has been in existence for three years and a half, and during that period has done a considerable amount of useful sanitary work. At the request of the Dublin Ladies' Sanitary Association, the

* Transactions of The National Association for the Promotion of Social Science (Dublin), 1881, p. 654, et seq.

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writer has undertaken to prepare this paper, with the view of again calling attention to the necessity for extending the work of such associations, and showing how much work may be done, *even* with the limited means at the disposal of the Dublin Association, and the great field that is open for women's work, in the improvement of the health of all classes of the community, but especially among the lower stratum of the social fabric in great towns. The opportunity is specially appropriate, as the London Ladies' Sanitary Association is affiliated with this Institute, as it also is with the National Association for the Promotion of Social Science, and the Dublin Ladies' Association has now reached a sufficient age to fairly claim to be admitted to the sisterhood.

The Committee of the Dublin Ladies' Sanitary Association considered that they should not lose the good opportunity afforded by the meeting of this Congress to bring forward the advantages of "Ladies' Sanitary Associations"; in other words, woman's help in the cause of sanitary science, and the claims of the Dublin Association to sympathy and aid. It is now fully acknowledged how important healthy conditions of life are for the happiness of the people, and what ignorance and indifference exist with respect to them among the poorer classes, and perhaps among all classes in certain degrees. It is also fully acknowledged that it is one of women's especial works to visit the poor; this is done in many different ways, and for various purposes: for trying to carry religion into houses where it is little thought of, or for visiting the sick, or for the conveyance of charitable relief of different kinds. Now, among all these perhaps there is no cause in which woman's tact and sympathy should be of more value than in instructing the poor in the simpler truths of "sanitary science." There are many things which could be noticed by a lady visitor, as a woman among women, which would be passed over by regular sanitary officials, or if noticed by them, perhaps objected to as an interference, and perfectly unheeded. The inspector of nuisances, or other official, can see to the formation of drains, to proper house accommodation (as to space), or objectionable occupations, &c., but he cannot enter into the question of personal cleanliness, the proper care, cleanliness, and clothing and feeding of children, or of the food used. It must be very difficult, we all acknowledge, for the people to which I refer to carry out any cleanliness in the "dens" in which they live, but they *must have* the *knowledge* given them, and the belief in its efficacy instilled into them, before they will even make the *attempt*. The hardest part of the work is to make the lower classes *understand* the importance

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of cleanliness, to make them see the advantages that will accrue to *them* from it, and persuade them to *try* it. If once they get their interest aroused it will be easy to show them what to do. We all must know the difficulty that housekeepers find among their servants in making them cleanly in their work and persons; they seem to think one brush should sweep many different kinds of things, and one duster dust several rooms. I was once told that a washstand and belongings in a bedroom were quite unnecessary, as the servant in question could use her pantry! and this by one supposed to have come from a most respectable home; and at another time, on asking if the personal washing had been properly carried out, the answer was, "Oh, ma'am, it was only a fortnight ago or so!" Change of clothing, too, sufficiently often, is much neglected by domestic servants, and if this be so among a class who have mixed for some time with those above them, and lived among cleanly surroundings, how much more likely will it be among the class who never go out of their own sphere, and never see or hear anything better? It therefore seems that on all these points the visitors of Ladies' Sanitary Associations can be of so much use; they can instruct the women about fresh air in their rooms; cleaning their rooms, themselves, their children, and clothing, explain the necessaries required for these purposes, and help them to get them; they can explain how they and the children must suffer if they use dirty water or dirty food, such as cheap unwholesome fish or meat (as a treat), or if they let their children eat food picked up, sometimes in yards or dust heaps, unripe apples, and many things of the kind.

They also have the power and advantage of acting as "go-betweens" between the tenants of these wretched places and the owners, and where perhaps a complaint would not be made by the tenant direct to the owner of something neglected to be done in the way of repairs or cleaning, for fear of being turned out, or rent being raised, it could be mentioned without fear to a lady visitor, who might bring it before the proper health authority. There is in London a special society for this purpose, called the "Sanitary Aid Society." Another very important good that can be effected by lady visitors is the prevention of the spread of infectious diseases, thereby not only benefiting those visited, but the whole community. The first thing to be done, where there is any sign of sickness, is to overcome the objections (which are, I believe, generally strong) to sending the sick person to *the hospital*, and to point out to the women how much better sick people can be cared for in a hospital than in their own homes, and how much it will increase the chance of recovery. They can also be persuaded to *notice*, at *once*, any sign

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of illness in themselves or families, have medical advice at once, and learn where and how to obtain it. They can also be taught the value and use of cheap and easily procured disinfectants, and the necessity of keeping separate, and washing separately, as far as is in their power, the things used by any of them who *seem* sick, even if they do not know what is wrong. These are points which would not, and could not, be entered into by any sanitary authorities, and which the people themselves are unlikely to *know* of, or indeed *think* of. In fact, the good that might be done by Ladies' Sanitary Associations, if efficiently worked, and worked *by those who take a thorough interest* in them is incalculable, but the visitors require great tact and discretion, as no doubt it would be difficult to broach such unwelcome subjects without hurting the feelings or appearing to interfere too much in the privacy of home arrangements. It is here that lectures, and especially the lectures given by ladies conversationally in the district rooms, prove such useful helps. To quote an extract, from the London Report of 1884, of a letter to Miss Adams from a lady at Derby: "One is able to say in open lecture many things which politeness makes it almost impossible to speak of in an individual cottage."

One very hopeful and encouraging fact has been proved by the district visitors, namely, that in their rounds of visiting they have always been well received, and when known among the people of the district, they have been received with welcome, and their visits looked forward to with pleasure. To quote from their last report: "If there is any interruption to their visits, they constantly ask, 'Why don't the ladies come to us?'" As there was considerable doubt in the minds of some persons about this, when the district visiting was first arranged, it is well that it should be made widely known, as the fear of meeting with any disagreeable opposition might deter some from becoming district visitors.

There have been several such associations founded, which are working well; and I see from the last report of the London Ladies' Sanitary Association, kindly sent by Miss Adams, its secretary, that the good influence has extended to Australia, there being an "Australian Health Society" in East Melbourne.

To give an example of how largely the London Society is disseminating sanitary knowledge, it may be mentioned that there have been 1,535,620 pamphlets published and reprinted since 1859, besides leaflets, &c., and a mass of inquiries answered; and from their report we also see that many of these pamphlets are to be translated into Japanese, Chinese, and modern Greek.

The London Association has taken up the questions of seats in shops, early closing, play-grounds for children, bread reform,

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matrons' aid (or midwife's) institutes, lavatories for women and children, &c. Of course these are the result of many years' work by many workers, and the Dublin Association has not had time to do more than commence with the most simple groundwork, which, however, it is hoped will be a foundation for all these other branches.

The Dublin Ladies' Sanitary Association was founded in 1881, by Miss Hamilton Stubber. Its first President was The Countess Cowper, and it now has the honour of having as President The Countess Spencer, who has on every possible occasion shown her sympathy and given her aid to the Society. For full particulars of the work done by the Ladies' Sanitary Association of Dublin, I must refer you to the Report for the year ending 1884; but some of the details of the work may be briefly referred to. Pamphlets have been distributed; lectures given to ladies, and also to wives of working men; a lending library established. Classes have been formed for training lady visitors in hygiene and domestic sanitation, and in connection with these there have been examinations, and certificates and prizes awarded. This is considered a valuable part of the work, as *it is of great importance that those who are to teach others should be thoroughly* grounded in the necessary knowledge. Lectures have been given in the district-room to the women and girls of the neighbourhood by ladies, and also practical lessons in cookery. Another important part of the work of this Association has been the attention drawn to the matter of including hygiene in the course of instruction in National and other schools. In two of the Roman Catholic training colleges it now forms part of the course; and, owing to the application by Lady Cowper to Sir P. Keenan, the Board of National Education took up the question, and a committee was formed to inquire into it; it is hoped that the result will be satisfactory, and that the children of the present day will learn what will make them healthier and happier than their parents have been, and enable them to render their future homes healthier and pleasanter dwelling-places than those at present inhabited by the majority of our working class.

Lastly, though it is perhaps the most practical and important part of the work, there is the district visiting. Unhappily, the districts at present worked in Dublin only number *two*, owing to the want of *visitors*. The committee have tried in every way to attract ladies as visitors, but hitherto it has not been taken up with sufficient zeal, and this seems the more surprising, as happily in this work "creed" makes no difference. Protestants and Roman Catholics work together, with the approval of the clergy on both sides. Surely there must be some women in

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Dublin who are not tied by houses and children of their own to look after, and who could undertake the work, and find occupation and pleasure in it. Is Dublin incapable of producing a second Miss Octavia Hill, or Miss Adams, or even followers of theirs? We had hoped to have succeeded in persuading Miss Octavia Hill to come to Dublin to attend this Congress, and by her presence, and perhaps words, to have roused and inspired some in Dublin to follow in her footsteps, and do for "Dear dirty Dublin" what she has done for London; but, unfortunately, her own work, in her own especial town, is more than enough for her, and in a letter she says she has undertaken more work, "which will require much thought and work." The next best thing is to ask any ladies inclined to interest themselves in this work to *read* an account of what Miss Hill has done, and study her opinions and advice on the subject. As before mentioned, plenty are found to be district visitors for other purposes, and possibly in pleasanter and easier ways than for sanitary work; but if it be remembered that "Cleanliness is next to Godliness," and that, in fact, they must and do go together, some will be found to work in the "straight and narrow way," which will lead to the other and higher work. In conclusion, the writer begs to say that she has prepared this paper simply to bring under public notice the importance and value of associations of this kind, and to ask for *workers*, and not in any way as a paper for scientific discussion.

Dr. Alfred Carpenter (Croydon) remarked that the Ladies' Sanitary Association was helping the work of the Sanitary Institute very much, and he therefore hailed the establishment of this association in Dublin with the very greatest pleasure. The knowledge that the Countess Spencer was at the head of this association, and that other ladies would certainly imitate her example, led him to hope that the result would be accomplished here more extensively, comparatively, than the work that was being done in London under Miss Octavia Hill. There was much more in connection with beneficial sanitary work than a consideration of drain pipes; it branched out into all those points which had been noticed in the paper, and in many other directions besides. One of the most important branches was the endeavour to get some better ideas into the lower classes as to what the education of their children should be, and as to the way in which they should be brought up to face the difficulties of life. He sincerely hoped that the movement might meet with the support of the ladies of Dublin who were anxious for the welfare of their own beloved ones; for who could tell from what cabins or hovels

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sickness might be brought into the homes of the richest in the land?

Mr. H. H. Collins, F.R.I.B.A. (London), considered that the truest way of dealing with sanitation was that marked out by the Ladies' Sanitary Association. Work undertaken in the spirit of a remark to be found on page 7 of their annual report, "that until ignorance of the laws of health was dispelled amongst the poor, little improvement could be expected," was certain to accomplish great good. Having visited several of the slums of Dublin on the previous day, he felt bound to say that it was all very well for them to preach what should be done by the poor and what should not be done, but any one who saw their wretched homes must admit that it was almost impossible for them to have any ideas of sanitation, and that even if they could be impressed with their necessity it would be impossible, under the existing conditions, for them to carry them out. He was surprised that the people were so patient and so good, considering the miserable lairs which they had to exist in.

Dr. Charles A. Cameron (Dublin) observed that a larger proportion of the population of Dublin was in a state of more abject poverty than was to be found in any city in England. You could walk for miles in London without meeting a really bad street or a number of dilapidated houses, but you could not pass out of any of the fashionable squares of Dublin without going through streets in which the people were steeped in wretchedness and poverty. That state of things was general throughout this decaying city. The purlieus of Dublin were worse than those of London. It was therefore nonsensical to compare the communities in the two cities. It was surprising to him that the death rate in Dublin was only 27 per 1,000, and not about 33 per 1,000; and he was happy to find that though it exceeded the death rate of London, it was lower than the death rate of most great cities on the Continent. He heartily approved the objects of the Ladies' Sanitary Association. Few were better qualified than he to express an opinion as to the value of their work. He had noticed how frequently they had called the attention of the Sanitary authorities to neglected places. He thought the large mortality in this city arose in part from the insufficient feeding and clothing of the children, and this remark applied not merely to the poor, but also to the well-to-do people. He had been surprised to find women of the middle class well and comfortably clothed themselves while the arms and legs of the children whom they were dragging out with them for their miserable walks were purple from cold. The Ladies' Sanitary Association had a great work to perform, and he was surprised so few ladies were taking an interest in it. Great as had been the work done up to the present, vast was the amount which still remained to be accomplished. Thirty-three thousand out of the fifty-four thousand families residing in the city were living, on an average, in one and half rooms per family. He thought the best way to improve

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Dublin would be to improve two-thirds of the habitations off the face of the earth. He took some little credit to himself for having, by persistent agitation—that was the only way we could get anything in Ireland—induced the putting in force of the Artizans' Dwellings Act. They could not expect landlords to provide decent dwellings for people so sunk in poverty, that perhaps they could only pay one week's rent in every four weeks. What he had always contended for was that it was the duty of the Municipal authorities to provide dwellings for the lowest and most wretched stratum of the population. There were ten thousand people in the city requiring house accommodation who could not afford to pay a rent higher than one shilling per week. Plans were now being prepared, he was glad to say, for the erection of houses upon corporate property which would suit people who could not afford for rent more than one or two shillings per week.

Dr. MacDowel Cosgrave (Dublin), Hon. Secretary of the Section, contended that the poverty of the lower classes would not be so great if less money were spent on intoxicating drinks, and urged that the Sanitary Associations should not attempt to ignore the fact.

Sir Robert Rawlinson, C.B. (President of the Congress), said that before a remedy could be applied it was necessary to probe the wound to its greatest depths. This negligence of the lower stratum of society did not belong solely to despotisms or to so-called Free Governments, or to Republics. There was as much destitution under one form of government as under another, as in the cities of the American Republic there was overcrowding, neglect, vice, and destitution equal to that of the great cities of European kingdoms or in Great Britain. It had arisen from a social neglect—from a blindness and an apathy which allowed the lowest stratum of society to degenerate into a condition out of which they themselves could not by any possibility escape. But in looking at that state of things there was another rock to be avoided. It had been said, and he supposed in some respects it was true, that charity covered a multitude of sins. Some persons, he dare say, imagined that by distributing alms broadcast, by giving freely of their substance, they were doing a certain amount of good. It had been one of the tasks of his life to investigate what were called charitable endowments, in different parts of the country. These endowments had increased to an enormous extent in some instances, and as wealth had increased abuse had increased with it, until his observations forced him to say "Show me a largely endowed district and I will show you a corrupt population." Where charitable endowments were relied on they took away the self-reliance of the population and led to idleness; therefore they must be cautious in attempting to do good that they did not make greater evil. "Under no circumstances can relief be given in money," was an admirable rule of the Ladies' Sanitary Society. The prime question of putting the poor into a proper condition was, however, a Statesman's work. The laws must be so framed, so regulated, and so

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administered, that there should be relief without communism, for woe be to that nation when the people ceased to rely on their own endeavours, and looked to the ranks above to feed, clothe, and take care of them; disruption must soon come. It was their duty to strive by all the means in their power to give means of health, comfort, and religion to every human being born into the land, and they must then, by constant reiteration, constant attention, and constant labour attempt to keep that arrangement. Relief must come from above and it must be imparted to those below. Take the slums and tenement-houses of any town, and preach from Christmas to Christmas to the shivering, starving inhabitants on the advantages of clean rooms, fresh air, ventilation, warm clothing, and wholesome food, abstinence from drink, and attendance to religious duties, and do nothing more, and insult will be added to injury. Just as well tell the blind to see, the deaf to hear, the lame to walk, as to tell these people to be well-housed, well-clothed, and well-fed. They cannot provide their houses but, perforce, occupy the dens society allows to exist. He proposed a vote of thanks to the author, and wished God-speed to the work of the Ladies' Sanitary Association in Dublin.

On "The Homes of the Working Classes in Dublin," by EDWARD SPENCER, M.A., T.C.D., Secretary Dublin Artizans' Dwellings Company, Limited.

THE difficulties of dealing with the re-housing of the poor by general legislation are very great, owing to the diversities of conditions in different towns being such as to call for legislation of a local character. Among these may be mentioned the habits of the population; the development of various industries demanding space; schemes for railway improvements, selecting, where possible, poorer localities; movements of population out of towns to suburbs, emptying better class houses.

A more important difference, perhaps, is that between the growth of popular opinion on the subject in various towns. We have, on the one hand, the example of Glasgow, which twenty years ago recognized the evils caused by its then condition, and led the van in this great work; and on the other the case of an English town, where the local authority took preliminary steps under both Sir R. Cross's and Mr. Torrens' Acts, but abandoned them, notwithstanding the representations of their medical officers of health, and finally

questioned the right of the Local Government Board to interfere in the matter.

But the greatest difficulty in dealing with this question by general legislation is, that it is now happily recognized that the improvement of the homes of the working-classes cannot be effective without the improvement of the classes themselves; and the latter does not depend on legislation alone, but on the proper administration of the existing sanitary laws; of general laws relating to the homes of the poor, which of course differ in various towns; in a very great degree to the education of the masses, and to the material prosperity of a town; and to a variety of circumstances affecting more or less, according to local influences, the lives of our poorer brethren. For these reasons, and because Dublin, of all cities which have carried out improvements of this kind, is most peculiarly situated, I propose to discuss the subject of this paper from a local point of view, and from the following standpoints:—

I. THE WANT.

II. THE STATUTES RELATING TO THE SUPPLY OF THE WANT.

III. HOW THE WANT HAS BEEN SUPPLIED IN DUBLIN.

I. *The Want.*—We shall better be able to form an idea of the present condition of the homes of the working classes in Dublin, by observing the changes which have taken place in them during the decade 1871–1881, more especially as the former year may be taken as the era of a more vigorous sanitary administration in this city.

In 1871 there were, out of a total number of 58,327 families, 44,933, or 77 per cent., living in 10,954 tenement houses, being 4·1 families to each house—the term "tenement" being applied to all houses, of whatever size, accommodating more than one family. In 1881, out of 54,725 families, 39,997, or 73 per cent., lived in 9,854 tenement houses, or 4·05 families per house. The number of persons to each family had, however, increased from 4·2 in 1871 to 4·5 in 1881.

I have classified the tenement house accommodation afforded into seven grades. The highest consisting of houses of 10 rooms or more, occupied by 2 or 3 families, and the lowest being houses of 1 room, occupied by 2 or more families—a class of accommodation which had happily disappeared in 1881.

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TABLE I.

Classification.	Houses.			Families.		
	1871.	1881.	Increase or Decrease.	1871.	1881.	Increase or Decrease.
1. Houses, 10 rooms or more, occupied by 2 or 3 families	1785	1325	—460	4382	3247	—1135
2. Ditto, 5 to 9 rooms, occupied by 2 or 3 families.....	3274	3317	+43	7776	7906	+130
3. Ditto, 10 rooms or more, occupied by 4 or 5 families	1636	1298	—338	7368	8878	—1490
4. Ditto, 10 rooms or more, occupied by 6 or more families	1998	1743	—255	15021	12987	—2034
5. Ditto, 5 to 9 rooms, occupied by 4 or more families	2040	1983	—57	9893	9575	—318
6. Ditto, 2 to 4 rooms, occupied by 2 or more families	216	188	—28	493	404	—89
7. Ditto, 1 room, occupied by 2 or more families	5	...	—5	12	...	—12
TOTAL.....	10954	9854	—1100	44945	39997	—4948

The following table will show the single house accommodation in Dublin in 1871 and 1881:—

TABLE II.

	Houses and Families.		
	1871.	1881.	Increase or Decrease.
1. Houses, 10 rooms or more	5033	4692	—341
2. Ditto, 5 to 9 rooms	6141	7766	+1625
3. Ditto, 2 to 4 ditto	1675	1876	+201
4. Ditto, 1 room	86	14	—72
TOTAL	12935	14348	+1413

It will be seen from Table I. that of 1,100 tenement houses which have disappeared, 1,053, occupied by 4,659 families, contained more than ten rooms, and from two to six families each. It is certain that this decrease would have been much larger but for the constant supply of first-class single houses which have lapsed into tenement houses. The tables also show that while the decrease of families of all classes amounted to 3,538, those occupying tenemental dwellings have decreased by 4,948, and that the difference represents 1,413 families who have advanced to single house accommodation. While this transference is

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satisfactory, it must not be forgotten that the accommodation of the families remaining in the old dwellings has deteriorated, as the diminution in the number of tenement houses is almost altogether confined to those affording large accommodation while the decrease of houses containing from four to nine rooms, and from two to four or more families, is almost imperceptible, and with this must be taken into account the increase of the proportion of persons to each family in 1881.

On the whole, we have the broad fact that in 1871 77 per cent. of the families in Dublin, or 188,769 persons lived in tenement houses, and that this proportion was only reduced to 73 per cent., or 182,278 persons in 1881.

With reference to the condition of these houses, it was sworn before the Royal Sanitary Commission on Dublin in 1879 that of 9,760 which then existed, 2,360 were unfit for human habitation, 3,500 were repairable, and 4,000 in a better condition. Although private enterprise may supply a number of new dwellings equal to those which are closed by decay and from want of sanitary accommodation, the number of existing tenement houses will be maintained by the annual supply of second-hand dwellings converted from single houses, and it is out of the question to expect that the great majority of the working classes in this city will have any accommodation for many years to come, but that provided by tenement houses.

The want seems therefore to be of two kinds :—The demolition of old and substitution of new buildings, and the proper maintenance of existing dwellings.

II. The statutes relating to the supply of the want.

In dealing with this branch of the question, I shall refer to the laws relating first to the provision of new, and secondly to the maintenance of existing houses.

II A. The principal statutes affecting the demolition and reconstruction of dwellings, in force and relating to Dublin, are :—

a. The Artizans' Dwellings Acts (Sir R. Cross).
b. Those portions of Torrens' Acts relating to demolition and reconstruction.
c. The Labourers' Dwellings (Public Works Loans) Acts.
d. The Valuation Act.

a. The Artizans' and Labourers' Dwellings Improvement Act, 1875 *and* 1879, *and the Artizans' Dwellings Act,* 1882, *Part I.*

Two areas have been cleared in Dublin under the provisions

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of the Artizans' Dwellings Act, 1875—that known as the Coombe area, containing 4¼ acres, now built over by the Dublin Artizans' Dwellings Company; and the Plunket Street area, containing 3½ acres, just cleared.

I append a table giving details as to valuation and cost, &c., of the two schemes, to which I shall have occasion to refer when discussing the objections urged against the working of the Act in Dublin.

	Population.	Valuation.	Amount of Agreement Purchases.	Arbitrators' Awards.	Additions by Juries.	Costs of Traverse.	Total cost of Scheme.	Percentage of Increase of Total cost over Valuation.
		£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	
Coombe....	984	108 7 9	Nil.	14421 9 4	1349 15 10	212 14 6	15983 19 8	48
Plunket St..	1619	12470 0 0	11130 5 8	7936 17 2	48 0 0	20 0 0	19135 2 10	52

These objections may be summed up as follows:—

1. Compensation to weekly, monthly, and yearly tenants.
2. Large increase of arbitrators' over valuer's award.
3. Appeal to jury.
4. Unfair interpretation of the words "fair market value."
5. Excessive compensation for trade disturbance.

1. The compensation to 266 weekly, monthly, and yearly tenants on the Coombe was £1,397 4s. 10d., including traverses and costs. In Plunket Street area a more rigid application of the existing law was enforced, and no compensation awarded to any such tenants. Some idea of the amount saved to the rate-payers by this improved procedure may be gathered from the facts that out of a total number of 159 houses on Plunket Street area, 129 were "tenement," containing weekly tenants (who in the Coombe area were each awarded 26 weeks' rent), and that the amount claimed for the tenancies under discussion was £20,398 10s.

2. The large increase of the arbitrators' over the valuer's award in both schemes is remarkable; in the Coombe it is 48 per cent., in Plunket Street 53 per cent. In neither scheme was there any appeal by the Corporation against the arbitrators' award. Having regard to the favourable consideration nearly always given by Dublin juries to every claim by a private citizen against a public body, it might not have been of much use for the Corporation to have appealed against the arbitrators' award, but although the same tendency prevails in London and other English towns, there were several appeals against the arbitrators' awards successfully fought by the local authorities there with

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the twofold advantages of considerably reducing the awards and inducing the withdrawal of appeals on the opposite side.

3. With reference to appeals to juries, the law on the subject has been altered since the completion of the Dublin schemes, and no appeal to a jury can now be made except in cases where the award exceeds £1,000. In 9 traverses on the Coombe area the arbitrators' award was increased by £1,349 15s. 10d., or nearly 120 per cent.; and in 6 traverses in Plunket Street the increase was only £48, with £20 costs. None of these awards were over £1,000, and while the new legislation on this subject is specially useful in Dublin, where the amounts in dispute are generally small, the facts of the excessive compensation awarded by the juries in the Coombe traverses point to the necessity for abolishing appeals to juries, and making the arbitrators' decision final, as in Torrens' Acts. I think the following remarks of Mr. Goddard, chief surveyor to the Metropolitan Board of Works, in his evidence before the Select Committee of the House of Commons, will be appreciated by those who have had experience on the subject in this city. He says, "Although the evidence I have put in shows that in our appeals from an arbitrator to a jury we were successful in reducing the amount awarded, I think, looking at the case from an economic point of view I should, having appointed an official arbitrator, make the appeal to him final. . . . When you take twelve men haphazard selected out of society here, there, everywhere, men against whose judgment and honesty we can't say a word, but who may be led away by the forensic eloquence of some honourable member of the Bar, or by the authoritative swearing of some honourable member of my own profession, it is a toss-up as to which way the jury will go."

4. The law on the interpretation of the "fair market value" has been much improved since the Act of 1875. The arbitrator is now bound to consider, in the case of an unhealthy house, what would be its value if its condition was remedied, and to deduct the cost of such improvement from his valuation. I suppose there were not 5 per cent. of the dwellings in Plunket Street area which would not have come under the definition of an unhealthy house. The words "and all circumstances relating to such value," in the section of the Act referring to the principles of the arbitration, have also been struck out, as their vagueness tended greatly to increase the valuation. The consideration of the arbitrator is now practically limited to the present state of repair of the buildings, and their probable existence in that condition.

5. Compensation for trade disturbance is the most difficult question of all to deal with by general legislation, and the Select Committee could not see their way further on this point than

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to make a recommendation to arbitrators to consider well in all cases whether the trader has not the option of setting up his trade somewhere in the immediate neighbourhood, without positive injury. While, on the one hand, there is no doubt that in Dublin many small traders, whose tenancies are monthly and even weekly, have suffered hardship from compulsory removal without compensation, it is equally true that the small trader who gets moderate compensation for disturbance and has the chance of setting up his business in any other district he likes, is much better off than the trader who lives across the street, gets no compensation, loses his business through the clearance of an area, and finds, when the area is repeopled, that the new inhabitants are of a class quite different to that which patronised his wares. I know of several such instances in the Coombe area.

We see, then, that the expense of carrying out an improvement scheme has been greatly reduced, both as regards administration and legislation, since the Coombe area was cleared; and is capable of further improvement in both directions; that (1) compensation to weekly, monthly, and yearly tenants has been abolished; that (2) the example of English towns may well be followed in appealing against the arbitrators' award if it be excessive; that (3) in cases under £1,000 appeals to juries have been abolished; that (4) the principles on which "fair market value" is assessed are defined with much greater clearness, and established on a more equitable basis; and that (5) the necessity for careful investigation into the nature of "trade disturbance" is impressed on the arbitrator.

Two other important amendments have been introduced, which deal with evils of which we have fortunately had but little experience in Dublin, viz., that no compensation shall be allowed for (1) any improvements to the property to be acquired under the scheme, made after the publication of the advertisement under Sec. 6; and (2) for any interest similarly acquired.

Having pointed out the improvements which have been made in the Act since the adoption of two schemes in Dublin, I may be permitted to urge the importance of taking fresh action. Although of the nine areas reported under the Act as unhealthy in 1876, five have been practically cleared, those remaining are in a much worse condition than then, and there are other areas for which there is no effective remedy but demolition and reconstruction. Believing that a large number of the richer inhabitants have no idea of the depths of misery, filth, and degradation in which a large proportion of the population exist, I append a description of Plunket Street area, kindly supplied to me by Mr. Harty, C,E., assistant engineer to the Corporation, who acts as surveyor to the Artizans' Dwelling Committee of that body.

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"Accordingly as the houses in Plunket Street area were taken over by the Corporation for demolition, they were found to be in a shocking state. House after house was in a most foul and filthy condition—which almost beggars description—and the stench through the houses was most intolerable from human filth, which was allowed to accumulate on the landings, stairs, floors, &c., and actually, when taking down the houses it was found that between the flooring boards and ceilings underneath, filth and dirt of all sorts were packed so tightly as to become one solid mass; holes were cut in shop floors so as to make a common privy, thus making the basement the receptacle of filth; floors in the drawing rooms and top storeys were partly removed, so that there was actually no privacy in several of the rooms, filthy chaff beds were found by me in several places emptied out on the floors, the inhabitants not taking the trouble to remove the rubbish into the back yards; the smell was so intolerable in some instances, that I had to leave the houses quicker than I went in. In a great many of the houses, especially in Blackhall Row, old tubs, crocks, cans, and buckets were found filled with night soil, and hid away in the roof and other out of the way places, the removal of which was anything but pleasant to the men. The workmen were often literally covered with fleas, &c., and had to run away from their work and scrape each other's clothes down with sticks, in order to try and remove them, the colour of their clothes was hardly discernible. Beds and furniture of the simplest kind were a luxury unknown in several instances."

Bad as is the condition of things as described here, it is not a bit worse than large portions of the poorer parts of London; where, for example, in a street containing 41 houses inhabited by costermongers, 40 privies are utilised as stables for the donkeys and one is reserved for human beings.

b. Those portions of Torrens' Acts which refer to Demolition and Reconstruction (*Artisans' Dwellings Acts*, 1868 *to* 1882).—The comparative failure of Torrens' Acts in London may be attributed chiefly to the system of Municipal Government in that city, whereby the expense of working the Act falls on the local vestry as distinguished from the metropolitan area; to the absence from the original statute of any adequate provision for compensating the owner of property affected (now provided for by the Act of 1879); to the difficulties attending the dual control of the surveyor and medical officer of health in the measures to be adopted in the case of an unhealthy or obstructive building; to the inability to interfere with buildings "obstructive" but not unhealthy (now provided for by the Act of 1882), and to the numerous cases on the one

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hand where the evil was so widespread as to require the application of Sir R. Cross's Acts, and on the other, where the object of the Act was attained by the commercial requirements of the district utilizing the sites of decayed buildings for warehouses.

It would be impossible within the limits of a paper such as this to give any summary of the provisions of Torrens' Acts, but it may be permitted to point out their special adaptability to Dublin, and the superiority of their measures relating to demolition and reconstruction over those of the Artisans' Dwellings Acts. The special applicability of Torrens' Acts to Dublin seems to me self-evident; and to say that it deals with the chief difficulties we have to meet is to recite the objects of the Acts. They relate to

1st. The demolition of unhealthy houses and reconstruction of suitable dwellings.

2nd. The demolition of houses not unhealthy in themselves, but rendering others unhealthy by reason of their proximity: and the opening up of courts and alleys by the removal of such obstructive buildings.

1. Everyone who knows Dublin will be struck by the large number of abandoned houses to be seen in comparatively respectable streets, and will not fail to observe the gradual injury inflicted by the condition of such houses on the adjoining ones. A great many of these houses have been closed by the medical officer of health as unfit for human habitation, or by the surveyor as structurally dangerous. I shall now only deal with those past repair. If the medical officer of health and the surveyor certify that the building is past repair and requires demolition and reconstruction, the owner or the local authority must take it down. The decision of these officers is final, and there is no appeal. This is a great advantage possessed by this Act over the Public Health Act, which requires the confirmation of a Justice's order before the house can be closed. If the owner elects to take down the house he may leave the site vacant if he wishes, but self-interest will be a sufficient guarantee in that respect. He can, however, call on the local authority to purchase the premises, in which case that body *must* take down the house, and *may* either erect labourers' dwellings or lodging-houses, dedicate the site to public health, or sell or let it without any special restrictions. For either of the first two cases they may borrow public money, but no greater rate than 2d. for one year can be levied. The purchase money is to be fixed by agreement or arbitration, and there is no appeal against the arbitrator's award. Here is a great advantage as compared with the Artisans' Dwellings Acts. In assessing the value the arbitrator is bound by the same principles as in Sir R. Cross's

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Acts, with the addition that he must deduct from his award such a sum as will represent the increased value given to other premises of the same award by the demolition of the buildings in question.

The great difficulty which is met with in Dublin in carrying out proceedings under this Act is to fix the liability on the rightful owner. This difficulty has been specially recognized by the Act and is minimized as far as possible by giving every encouragement to the honest owner to come forward. We have seen how he can compel the local authority to purchase the premises condemned; again, if he chooses to carry out the works ordered he is entitled, on production of the surveyor's certificate that the work is done properly, to an order charging the premises with a mortgage for 30 years at 6 per cent. on his expenditure, and this is recoverable just as a rent charge; of course it is only the limited owner who benefits by this provision, as the security from which he draws the rent charge is the improved condition of his premises. The definition of the word "owner" must be specially noted. He is any person who is enabled to sell land or premises, and all lessees or mortgagees except persons who are entitled to the rents and profits for a less period than 21 years. The value of this provision can best be appreciated when we consider that in the Coombe area the amount awarded to tenants, including costs, who held for less than 21 years was £1,980 19s. 2d. or 12 per cent. of the entire award: and the justice of it will be apparent when it is remembered that a large proportion of tenement houses in Dublin is in the hands of those whose margin of gain is the difference between due regard for, and gross violation of, the laws of health and decency.

2. The widening and opening up of alleys, &c., and the removal of obstructive buildings.—There is a large number of courts and alleys in Dublin which would be greatly benefitted by the removal of the buildings between them and the thoroughfares, which not only obstruct light and air but cut off the inhabitants from the public gaze. In this way the richer inhabitants would be shewn under what condition so many of their poorer brethren live; and the occupants of these courts would gain from being more under the eyes of their fellow citizens. On this subject Miss Octavia Hill says, "A great deal of the degradation of these courts is because no public opinion reaches them, if you hear anybody talk about a *cul de sac*, and contrast it with any place that is a thoroughfare, you feel at once that it is the public opinion that affects the character of a court more than police or anything else; the same thing is done by higher class people living amongst them." The only differences in pro-

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cedure between dealing with "unhealthy" and "obstructive" buildings are that in the latter the local authority may compel the owner to sell, in case he declines to demolish, and that in assessing compensation the increase of value of property of *other* owners caused by the demolition of the obstructive building is to be apportioned among such owners, and to be levied as a private improvement rate.

We see then that none of the conditions which conspired to impede the usefulness of Torrens' Act in London exist in Dublin, that on the contrary the condition and position of the homes of the working classes here renders an application of the Act peculiarly advantageous. The only improvement which appears necessary in the Act is the extension of its operations to more buildings than one, so as to effect the improvement of a block of houses in a street; and the recommendation of the Select Committee of the House of Commons to this effect has been to a considerable extent met by the provisions of sec. 6 of the amending Act of 1882, which lays down that where an official representation under Cross's Act refers to not more than ten houses, the local authority shall not take any proceedings on such representation, but shall direct the officer making same to report the case to the local authority under Torrens' Act, under which the local authority shall deal with the case.

c. Labouring Classes Lodging Houses and Dwellings Act (Ireland), 1866.—This Act provides for the advance of public money by the Commissioners of Public Works in Ireland for the objects stated in the title of the Act, subject to certain conditions for the repayment of such loans. The period of repayment is limited to forty years as a maximum, and the term of interest to 4 per cent. minimum.

The Public Works Loans Act, 1879, section 6, enables the Public Works Loan Commissioners (an English body) to lend money for the construction of dwellings and purchase of land, repayable within a period not exceeding fifteen years, and at a rate not less than 3½ per cent. The Public Works Loans Act, 1881, which relates to Loans made by the Commissioners of Public Works in Ireland, enacts that the period of repayment and rate of interest of any loan made under the Act of 1866 may be such as is mentioned in that Act—viz., forty years and 4 per cent—or in the Act of 1879, viz., fifteen years and 3½ per cent. Although the reduction of the rate of interest is a concession, the short period fixed for repayment makes it practically of no value, as in the case of a loan made by a public company the annual instalments of repayment would be so large as to unduly absorb the annual capital income.

In 1883 the directors of the Dublin Artisans' Dwellings Com-

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pany made a representation to Government, requesting that the period of repayments should be extended to forty years, as in the Act of 1866, instancing the analogy of the Public Health (Ireland) Act, by which loans for sanitary purposes are granted at 3½ per cent., and the repayments spread over fifty years; and offering, in case the application was granted, to largely extend their operations. The request was, however, refused.

d. Valuation.—The greatest bar to the improvement of the homes of the working classes in Dublin is the present anomalous condition of the valuation of property. This affects not only the provision of such dwellings, but the improvement of every class of buildings. The shortest way of indicating the present state of affairs is to give an example from each kind of property, although it might be sufficient to state that there has been no general revision of the valuation of the city for thirty-five years. There have been five commercial houses, in the vicinity of the leading business thoroughfares, lately rebuilt at a total cost of £12,750. Before their re-construction their valuation amounted to £532, now it is £925. Taking the rates and taxes at 10s. in the £1, the increased annual expenditure of the five investors under this head was £196 10s., or, at twenty-five years' purchase, £4,912 10s., or 38½ per cent. on their outlay on buildings. Possibly they would not have objected to this, but that the proprietors of the adjoining places of business who did not care, or were not bound to rebuild their premises, have their valuations unaltered, although they derive considerable benefit from their neighbours' improvements.

Passing to the homes of the working classes, and selecting at random seven tenement houses in various parts of the city, and seven improved dwellings, the valuation of each being the same, viz., £9, or £63 for all, I find the annual rental of the old houses to be £322, of the new £118. That is to say, the proprietors of the tenemental dwellings contribute 10 per cent. of their income to the rates, while the owners of the new dwellings pay 27 per cent. of their income to the rates. This inequality presses on the very class we are supposed to be benefitting, as the following facts will show. I have investigated the present and former rents paid by 427 of the tenants of the Dublin Artisans' Dwellings Company, and find the present rent to average 5s. 3d. per week, the former rent 4s. 3d. Dividing these gross rents into the two items of "rent" and "taxes," and applying the proportion of taxes to rent given above, it will be seen that the "rent" of the new dwelling is 3s. 10d. and taxes 1s. 5d.; while the "rent" of the tenemental dwelling is 3s. 10d., and taxes 5d.; it will be therefore seen that the extra price which the tenant pays for the

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improved accommodation is made up entirely of increased taxation. In ninety cases the Company have been able to let their dwellings at a lower rent than those of the tenement houses, and in these cases the inequality appears still stronger. The gross rents in the old dwellings average 5s. 2d., in the new 3s. 7d.; subdivided, the former consist of rent 4s. 8d., taxes 6d.; the latter, rent 2s. 8d., taxes 11d. It may be urged that in payment of taxes, artisans' dwellings and tenement rooms are not strictly comparable, as the entire taxes have to be paid in tenement houses, if any portion of them be occupied, whereas artisans' dwellings are rated separately, and "vacancies" are allowed for. This advantage, however, is more than counterbalanced by the disadvantage under which artisans' dwellings labour, viz., that their higher rent removes the tenant from the control of the "Summary Jurisdiction Act," and makes him, though nominally a weekly, practically a quarterly tenant. The inequality of taxation for all such improvements presses with special severity on all sections of the lower classes in Dublin, for the very large proportion of new buildings erected for the past few years is for the lower middle and working classes. In many of the English towns special provision is made for the assessment of dwellings of the working classes, but in Dublin the homes of the rich and poor are valued under the same law. Whether the principle of taxation of improved dwellings for the working classes is just, will no doubt soon form the subject of serious discussion, but, be that as it may, it cannot be denied that a revaluation of Dublin is, in the interest of all classes, imperatively demanded. There are, however, three great obstacles in the way:—

1. The Acts which relate to the valuation of property in Ireland (15 and 16 Vic., cap. 63; 19 and 20, cap. 63; 23 and 24, cap. 4; 27 and 28, cap. 52; and 37 and 38, cap. 70), provide for a general revaluation after the termination of the first general valuation commenced in 1849, or of seven years after the date of the Act of 15 and 16 Vic. This revaluation can only be made by order of the Lord Lieutenant on the application of the grand jury, which application is voluntary; and no such application has been made by any grand jury, for reasons which it is not now necessary to dwell upon.

2. Even if the application were made and a re-valuation ordered, there is no provision for the cost. It is true that a small proportion of the cost of an *Annual Revision* is paid for by each county or city grand jury according to a schedule appended to 37 & 38 Vic., cap. 70; but the annual contribution for this purpose is for the City of Dublin only £200, while a general re-valuation of Dublin would cost a sum considerably in excess of that, and for which there is no legal provision.

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3. If a re-valuation were ordered, and the expense provided for (which can only be done by legislation), the effect would be, as far as Dublin is concerned, unequal and unjust. The valuation must be made according to unions or baronies, and the boundaries of these areas are not conterminous with those of the municipal district. The result would be that if the city were re-valued the new valuation would be much out of proportion to the existing valuations of the portions of the North and South Dublin Unions that are outside the city.

IIB. The statutes relating to the proper maintenance of existing dwellings.

In considering this branch of the question it may be premised that the proper maintenance of existing dwellings can be effectually attained by the administration of legislation in force and applied, or by the application of existing legislation.

The number of tenement houses in Dublin is being constantly increased by the conversion of single dwellings; and diminished by natural decay, demolition, or by being closed for want of sanitary accommodation. We have seen that the latter process is more rapid than the former; and, as it has been dealt with in discussing demolition and reconstruction, I shall confine my observations to the comparatively new and repairable tenement houses, dealing with each class under the statutes referred to, viz :—

1. Public Health Act.
2. Torrens' Acts.

1. *Public Health Act* (*Ireland*) 1878.—The powers given by this Act are extremely comprehensive, and the bye-laws under them relating to tenement houses sufficiently stringent. Commencing with those tenement houses which are converted from dwellings for one family, I should like to see the bye-laws put in force so as to prevent the occupation of such until the structural alterations necessitated by the changed condition of the house were carried out. Section 43 of the Act seems to exactly meet such cases; it brings under the definition of "new building" for which there are ample bye-laws as to the provision of light, air, and proper sanitary accommodation, "the conversion into more than one dwelling house of a building originally constructed as one dwelling house only." It has been urged that this provision does not refer to the alteration of private dwelling houses into tenement houses, and I shall therefore refer to the action taken in this matter by another city which has to deal with the tenement house evil. In Liverpool up to 1882 the corporation had no power whatever to prevent an owner from altering a private dwelling house so as to make separate sets of rooms in it, but by their Improvement Act of 1882, if any such conversion were now attempted the owner

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would become liable to the provision of the building regulations enacted in the same statute, and the corporation could then step in and insist upon proper space for light and ventilation, &c., being given to each tenant, and due provision being made for the segregation of different sexes. The definition of a "new building" in the Liverpool Act is, word for word, the same as that in the Dublin bye-laws quoted above.

Prevention is, in this case, much easier than cure, and the due administration of the bye-law referred to would have the effect of encouraging the owner to take the management of such property in his own hands, of checking the creation of the middleman or house jobber, or by preserving the house as a habitation for a single family, would diminish the supply of tenement houses. As I was anxious to illustrate the necessity of preventing the alteration of single dwellings into tenement houses without (either under the Public Health or Torrens' Act, or, if necessary, by new legislation) enforcing structural alterations necessary for its converted state, I selected a house at random in one of the finest thoroughfares in Dublin, and which has been converted within the past year into a tenement house, and through the kindness of Dr. Cameron, medical officer of health, am enabled to place on record its present condition; The house is occupied by nine families, but is in good order. the cubic space per head is not less than 300ft., and the house may be taken as a very favourable example of the tenemental dwellings in Dublin. Six rooms are occupied by as many families, containing 47 persons. and three rooms are occupied by three families, containing eight individuals. In the back kitchen live a family of six, father, mother, and four sons, the eldest of whom is 17, the youngest 10. The second floor front room is occupied by a family of ten, of which two are men over 25, two boys from 14 to 16, and three women from 23 to 40. In the top front room live another family of ten, comprising two males, one 19 the other 40, and four females, aged 10, 12, 14, and 36; and in the top back live a man, his wife, her mother, and a baby. All of the other rooms are occupied by families with children under 13 years of age.

With those houses, which have already been converted without any structural alterations, the task of the sanitary authority is much more difficult. While a large number of tenement house owners systematically evade the law in Dublin, there is a large number who honestly endeavour to do their duty, and to encourage whom should be the policy of the sanitary authority. Although under the Public Health Act the owner or occupier may be proceeded against for the creation of a nuisance, it is always the owner who is held responsible for every kind of

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nuisance, whether owing to structural defects or wilful destruction by the occupier. In the former case it may be just that the owner should be proceeded against, but it does seem a hardship that he should be held liable for nuisances altogether attributable to his tenants. It is true that there are bye-laws under the Public Health Act, by which a tenant may be prosecuted for misusing any appliance or depositing refuse, but the onus of bringing the prosecution and proving the case lies on the landlord, and I know of only one such prosecution being instituted under these bye-laws since their adoption in 1882. If an occupier is detected in throwing filth on the public thoroughfare he is proceeded against by the authorities, and there are special officers of the cleansing department of the corporation employed in detecting such cases; and it would be equally just, and would render the task of the sanitary inspector lighter in future, if the occupants of tenement houses were summoned in the case of a nuisance in the house, evidently due to their own wilful neglect or commission. In many English and Scotch towns, although the landlord is held liable for all structural defects, the tenants are proceeded against in the case of a dirty house, and this seems to be the spirit of the legislation on the subject.

There are, however, many cases of tenemental dwellings which cannot be effectually dealt with under the Public Health Act, and which require the application of

2. *The Repairing portions of Torrens' Acts* (*Artisans' Dwellings Acts*, 1868 *to* 1882).—If the local authority decide, on the reports of their medical officer of health and surveyor, that a house is dangerous to health, and that evils can be remedied by structural alterations, the owner upon whom the responsibility of executing the repairs devolves must carry out the works specified by the surveyor to his satisfaction, or pull down the premises. If neither he nor the other owners interested do so, the local authority must close or demolish the house, or may execute the necessary repairs. They are empowered to recoup themselves the expenses of demolition by selling the old materials, retaining the proceeds, and recovering the balance from the owner as an ordinary debt; and in the case of repairs they may apply to the Court of Quarter Sessions for an order charging the premises with all costs incurred, and with an interest of 5 per cent. The owner may, however, as in the case when ordered to demolish, compel the local authority to purchase on the terms previously explained.

It may be urged that alterations and repairs can be enforced under the Public Health Act. The improvements effected under that Act refer chiefly, if not solely, to the provision of

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sanitary accommodation, and to the maintenance of the fabric of the house, whereas the alterations contemplated by Torrens' Act refer rather to those necessary for the introduction of light and air, and for the separation of the sexes, &c. Even if these improvements could be effected under the Public Health Act, their enforcement would cause great hardship on the owner, while under Torrens' Acts there is every encouragement given to the owner to carry out the necessary works. It must not be forgotten that the difference between the "owner" of Torrens' Acts and the "owner" of the Public Health Act is very wide. Under the latter Act the owner is frequently a person who has a very short lease of the premises, and it would be obviously unfair to expect him to carry out permanent improvements, the benefit of which he will not reap. Indeed, the provision of improved sanitary accommodation involving drainage and water supply, under the Public Health Act, often presses so heavily on this class that many of them cannot afford to carry out the works, and the local authority has no alternative but to close the house. The worst use to make of a repairable house is to close it, and the result is seen in many of our streets where houses derelict are removed piecemeal, to the great injury of adjoining property, and to the demoralisation of the inhabitants.

Now, under Torrens' Acts, the responsibility of carrying out work is limited to those who hold for more than 21 years, and such owner who carries out the works to the satisfaction of the local authority is entitled to an order charging the premises with an annuity of 6 per cent. on the amount expended, payable for 30 years. Again, in the case of the derelict houses just referred to, the owner, as defined by Torrens' Acts, might be very willing to step in and do the repairs, but under the Public Health Act he is met by the short lease of his tenant, and if he proceeds for the legal recovery of his property, he finds, by the time he gets possession of it, there is nothing left but the site. Under Torrens' Acts, however, in the case of default by the owner on whom the responsibility for carrying out the works depends, any other owner who is interested in the premises can, on supplying proof that he will carry out the works directed, obtain an order justifying his entry on the premises, and his execution of the works in the face of any rights of possession.

Under the Public Health Act we often meet with the owner who evades the duties of property, and shields himself behind the house jobber, to whom he lets the house for a short time, without the slightest restrictions as to occupancy. If Torrens' Acts be applied, he will find it necessary to retain the manage-

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ment of his property in his own hands, or to let it for such a term, and at such a rent as will convert his tenant into an owner under those Acts, and give him a margin of profit sufficient to improve the sanitary condition of the premises.

For the reasons given the application of the repairing portions of Torrens' Acts in Dublin seems desirable. The only amendment which appears necessary, is the withdrawal of the right of the owner to compel the local authority to purchase his premises when they order the execution of repairs. It is quite fair to give this power to the owners when demolition and reconstruction are directed, as these may necessitate a large expenditure of capital, for which he may not be prepared, and will cut off his income during the process, whereas, the cost of carrying out structural alterations will not generally be large, and there will be practically no interference with the owner's income.

I have now referred to the principal measures dealing with the supply of new, and the maintenance of existing dwellings for the working classes. There are two statutes which affect incidentally, but to a very important extent, the supply of dwellings of both classes; and without a reference to which this paper would be incomplete.

The statutes are, The Summary Jurisdiction Act and the Improvement Act.

I. *Summary Jurisdiction* (*Dublin*) 1851.—This Act regulates the recovery of possession of small houses or tenements; it is limited to dwellings let under £12 per annum; and the possession of houses let at a higher rent can only be recovered by proceedings at Quarter Sessions. This limit is altogether too low. In London it is for similar proceedings £20 per annum, and there is no reason why it should not be raised to the same figure in Dublin. There are a large number of such dwellings in Dublin let at 4s. 6d. per week, and much below their value, simply because the owner shrinks from the liability to the large expense and loss of time incurred by proceeding at Quarter Sessions. The proceedings necessary to get rid of a tenant before the Court of Summary Jurisdiction occupy five weeks at the least, and practically involve the loss of seven weeks' rent; and the proceedings necessary to get rid of a tenant who pays more than 4s. 6d. per week occupy on an average three months. During all this time no rent is paid, and the property of the unfortunate owner is liable to the grossest injury without any practical means of redress. It is a well-known fact that there are tenants in Dublin who go from tenement to tenement, never paying one week's rent from year to year, and very often getting money from the landlord to give up possession. Every facility should be given to the landlord of tenement property

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to recover possession of his premises when it is considered how worthless is his security for rent and how great the risk of damage to his property. The condition of the law on this subject is one of the greatest practical bars to the improvement of the dwellings of the working classes.

II. *Improvement Act* (*Dublin*) 1849.—By Sec. 120 of this Act, the Town Council are empowered to compound with the owners of premises rated under £8 upon a reduced estimate of such annual value, not being less than two-thirds or more than four-fifths of the net annual value, at which the premises are then assessed, as the Council may think reasonable. Similar benefits are conferred on owners of such property in English towns, and in Liverpool there is not only a remission of 15 per cent. of rates to landlords of such property, but a further allowance of 10 per cent. to landlords who collect the rates from such buildings, and pay the entire amount, taking the risk for vacancies. In Belfast, under the differential system of rating very substantial advantages are afforded to houses rated under £20; and in the case of houses rated under £8 a discount of 25 per cent. for prompt payment of taxes is also allowed. The Corporation of Dublin have been requested to put in force the section of the Improvement Act referred to; and there is no doubt that its application would afford a great impetus to the erection of dwellings for the working classes, regard being specially had to the high valuation of such property. But it appears more than doubtful that the authority given under this Act can affect any rate not struck under the Act. If this view be correct the only relief which could be granted would be in respect of the Improvement Rate; and this being less than one-fourth of the entire rates of the city, the concession, if yielded, would confer but a very trifling benefit. Under such circumstances amendment of the law in conformity with that of Belfast is urgently required.

There is one great difficulty in Dublin in carrying out improvements under either Sir R. Cross's or Mr. Torrens' Acts, and that is that the area of taxation being limited the cost of such improvements presses heavily on the ratepayers in the municipal district. Without touching the question of the extension of the boundaries of that district, it may be pointed out that it would be not only equitable, but an act of self-interest in checking the spread of disease, for the townships outside the city to contribute to the cost of such work.

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III. How the want has been supplied.

I append a summary of the accommodation provided by the different agencies in Dublin during the last 10 or 12 years.

Erected by.	Place.	No.	Description.	Rent.
Dublin Artisans' Dwellings Co., Limited	Temple Buildings...	56	3 roomed tenements	4/3 to 5/3
	Echlin St. „ ...	24	3 „ „	4/3 „ 4/6
	„ „ ...	8	2 „ „	2/- „ 2/9
	„ „ ...	4	1 „ „	2/6 „ 3/-
	Buckingham „ ...	50	2 „ „	2/6 „ 4/-
	„ „ ...	30	3 „ „	3/- „ 5/-
	Temple Cottages...	23	4 „ cottages...	5/- „ 5/6
	Kirwan St. „ ...	41	4 „ „ ...	7/6 „ 8/-
	„ „ ...	47	3 „ „ ...	4/- „ 6/-
	„ „ ...	36	2 „ „ ...	3/6
	Buckingham „ ...	6	4 „ „ ...	5/6 to 7/-
	Coombe „ ...	48	4 „ „ ...	6/6 „ 7/-
	„ „ ...	90	3 „ „ ...	4/- „ 6/-
	„ „ ...	66	2 „ „ ...	3/6 „ 4/-
	Portobello „ ...	105	4 „ „ ...	8/- „ 8/3
	„ „ ...	49	3 „ „ ...	5/6 „ 6/-
	*Harold's Cross Cot.	76	2 „ „ ...	4/-
	„ „	76	3 „ „ ...	4/6 to 6/6
	*Rutland Street „	26	2 „ „ ...	4/-
	„ „	17	3 „ „ ...	6/3 to 6/6
	*Infirmary Rd. „	91	2 „ „ ...	4/-
	„ „	52	3 „ „ ...	4/6 to 6/6
	„ „	21	4 „ „ ...	8/-
Great Southern and Western Railway Co. of Ireland	„ „	141	6 „ „ ...	3/6 to 6/6
Midland Great Western Railway of Ireland Company	Constitution Hill ...	6	1 „ tenements	-/6 „ 1/6
	„ „ ...	17	2 „ „	1/- „ 2/6
	„ „ ...	7	3 & 4 „ „	1/6 „ 4/-
	„ „ ...	12	2 „ cottages...	1/- „ 2/6
	„ „ ...	14	3 „ „ ...	1/- „ 4/-
	„ „ ...	7	4 to 6 „ „ ...	2/- „ 5/-
	Monck Place.....	42	5 „ „ ...	6/6 „ 7/-
Industrial Tenements Co.	South Earl Street...	44	1 to 3 „ tenements	2/- „ 4/6
Messrs. A. Guinness, Sons, & Co.	Bellvue	51	2 „ „	3/-
	„	15	4 „ „	4/6
	South Circular Rd...	450	Cottages & tenements	under 5/-
On ground of Messrs. Lombard & MacMahon ...	N. and S. Suburbs...	83	3 roomed cottages...	6/-
	„ „ ...	125	4 „ „ ...	6/-
	„ „ ...	800	Larger	10/-
Thos. Vance, Esq. J.P.	Bishop Street and Kevin Street	144	1 & 2 „ „ ...	3/9
	Chapel Alley and Cook Street	88	2 „ „ ...	2/8
	Henrietta Street ...	14	1 & 2 „ „ ...	3/6

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It will be seen from the above summary that accommodation has been within a comparatively brief period provided, or is being provided, for 2,152 of the artisan and labouring class, and for 800 of a slightly superior class; in all, 2,952 families, representing about 16,000 persons.

Conclusion.

Summarizing the views put forward, it appears that the two-fold want in Dublin, viz., the demolition of old and substitution of new buildings, and the maintenance of repairable dwellings, can to a very great extent be met by existing legislation. The special laws on the subject—Sir R. Cross's, Mr. Torrens', and the Labourers' Dwellings Loans Acts—have been greatly improved within the past few years, and the most important alterations still required in them are perhaps, in Sir R. Cross's Act the abolition of appeal to jury; in Mr. Torrens' Act the extension of its provisions to more buildings than one, so as to effect the improvement of a block of houses in a street, &c.; and in the Labourers' Dwellings Loans Act the advance of money to companies and associations for the purpose of building labourers' dwellings, on the same terms as those which regulate loans for sanitary purposes.

But where new legislation is of far more importance, as regards Dublin, is in the alteration of those laws whose present condition tends to prevent the investment of money on purely commercial principles in the provision of dwellings for the labouring classes; I refer to the Valuation, Summary Jurisdiction, and Improvement Acts, the alteration of those portions of which referring to the subject, so as to be in conformity with the present necessities, and with the existing law in similar cities, is imperatively demanded.

While, however, legislation is so far responsible, we must not shut our eyes to the fact that an immense amount of improvement can be effected in the homes of the working classes in Dublin by the application of existing legislation, and by the administration of legislation existing and applied. There is great necessity not only for extended operations under Sir R. Cross's Act, but for a well-considered application of Mr. Torrens' Act to several streets on the north side of the city, which are at this moment adding private house after house to the list of tenement houses, each house not only altogether unsuited, but absolutely unfit for human habitation as a tenement house, and sowing seeds of never-ending trouble for the Sanitary authority.

And, in addition, there is required a vigorous and discerning

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enforcement of the existing sanitary laws, vigorous, in insisting on due observance of the laws of health, not only in the yard but in the garret; discerning, in not unduly visiting the sins of the tenant on the landlord. But the administration of Sanitary Laws by the Local authority depends on public opinion, and there is no doubt that within the past few years the action of the Sanitary authority in Dublin in effecting improvements has been distinctly in advance of a large mass of the public opinion on the subject, and it is worthy of notice that Dublin is one of the three cities in the United Kingdom which have carried out more than one improvement scheme under Cross's Act.

To educate that opinion among both the rich and the poor, to teach the rich the condition under which the poor—180,000 of them—live in tenement houses, so that the hands of the Sanitary authority and of public and private enterprise may be strengthened in improving that condition; and to teach the poor how they should live is the special province of Sanitary and Health Associations, and the bounden duty of every one acquainted with the Laws of Health. There is nothing more disheartening than to provide improved dwellings for those who do not seem to value them, and who do not know how to use them.

While many of the working classes eagerly embrace the opportunity of improving their domestic condition, afforded by the provision of new dwellings, there is, as is natural, a great deal of ignorance, of prejudice, and of obstinacy to be met with, and there is a large population in Dublin whose opinions on the subject of improved dwellings may be indicated by the aspiration of the old woman who, after gazing on the rows of new cottages in the Coombe thoroughfares, exclaimed, "God be with the good old times when there were no knockers on the hall doors!"

Dr. W. J. Simpson (Aberdeen) remarked that tenemented houses were one of the greatest difficulties sanitary authorities had to deal with. A building which had been occupied by perhaps two or three people, was converted into one of these dwellings, and after a time they might find a family occupying each room. A great deal would be gained if anything could be done by legislation to give powers to local authorities to limit this process of subdivision, and to force landlords who contemplated any such change in their property, to bring their plans before the authorities. An important point also for consideration was the non-liability of the tenant, who might wilfully destroy sanitary arrangements put thoroughly in order by the landlord, the sanitary authorities coming upon the owner of the house to repair the same.

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Dr. J. F. J. Sykes, Honorary Secretary of the Section (London), stated that he had been "slumming" in Dublin, and had never seen wider streets, wider courts, or wider alleys and slums elsewhere. The closes were so narrow in some of the Scotch towns, that people could not pass one another in them. In Dublin the buildings were only two or three stories high, while in Edinburgh they were twelve or even fourteen storeys in height. The greatest objection to the Dublin slums was that they were nearly all *culs-de-sac*, so that no wind draughts passed through them, and they were not likely to be visited by persons who would desire to institute changes. Again, if a slum were a short cut, the respectable persons passing through would have an improving influence upon the inhabitants. Wherever therefore there were houses, there should be a thoroughfare. It would be a mistake to pull down blocks of two-storied houses with fairly wide thoroughfares, in order to erect blocks of model dwelling-houses of many stories with narrow streets.

Mr. F. Pim (Dublin), in reference to one point in the concluding portion of the paper, dwelt upon the necessity for greatly improved facilities for dealing with non-paying tenants. Surely some means could be devised for meeting the difficulty. He had inspected many lanes and alleys of the city during the earlier years of the Sanitary Association, and nothing had struck him more than the number of them which led nowhere, but some improvement had taken place in this respect since the Association commenced its operations. Nothing tended more to eradicate evils of this kind than the letting in of the light of day and of public opinion upon them. A simplification of legislation in connection with the whole matter was urgently needed.

Mr. Parke Neville, C.E. (Dublin) thought there should be greater facilities given for obtaining possession of premises where improvements were about to be made.

Mr. R. O'Brien Furlong (Dublin) said one thing had rather surprised him, having regard to the population of the city and the increased accommodation provided for the working classes, and that was the small decrease in the number of tenement-houses. This small decrease was, he thought, due to the fact that as some tenement-houses were closed, other houses which had previously been private residences, were converted into tenements. He gave instances in Dublin where large houses once occupied by professional men had thus changed for the worse, and thought it would be a very good thing if something could be done to prevent this deterioration. He did not know, too, whether the Sanitary Association could do better than to promote legislation on the question of valuation raised by Mr. Spencer, and with a view to getting rid of bad tenants, cheaply and expeditiously, as suggested by Mr. Pim.

Mr. W. Stirling, C.E. (Dublin) thought it would be a good thing if encouragement were given to tenants to keep their places clean and in order, by holding out some such inducement as the prospect that the rent would be reduced after continued good tenancy.

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Dr. T. W. GRIMSHAW (President of the Section) approved this suggestion, and mentioned that the Brabazon Prizes had created a vast improvement in artisans' dwellings.

Mr. EDWARD SPENCER (Dublin) in reply, remarked that such a case as had been mentioned by Dr. W. J. SIMPSON could not arise under the amending Artisans' Dwellings Act, as no compensation was allowed for transactions taking place after notice of purchase had been given. The Act had been greatly improved in this and many other respects since its application in Dublin in 1876-9, but it had acquired a very bad name, which was difficult to be got rid of. He thanked them for the favourable reception accorded to his paper.

On "The Recent Progress made in some Branches of Ambulance Work," by V. B. BARRINGTON-KENNETT, M.A., LL.M., Deputy-Chairman St. John Ambulance Association.

I propose to deal with the subject of my paper under two heads. *First.* The work of the St. John Ambulance Association, with its extended organization of classes for teaching the principles of first aid to the injured and of home nursing, and the advance made by it in the design and construction of stretchers, litters, and other ambulance material; also its organization of corps of trained men qualified to use this material for *non-infectious* cases. *Secondly.* The recently organized ambulance system of the Metropolitan Asylums Board, insuring the rapid removal by road and river of persons suffering from small-pox and other *infectious* diseases from our crowded metropolis to be treated in the floating hospitals and convalescent camps established some twenty miles down the river, below London Bridge.

When I tell you that the result of the work of the St. John Ambulance Association is a little army of over 50,000 certificated pupils, while ambulance waggons and steamers of the Metropolitan Asylums Board, during the months of June and July last, were carrying infected persons away from London, and re-conveying them home when recovered, at the rate of nearly 400 a week, you will see that I have attempted a somewhat ambitious task, and can only touch slightly some portions of my subject.

At the risk of telling some of you what you know already, let me remind you that the principal object of the St. John Ambulance Association is to teach people what to do, in case of an accident or sudden illness, until the doctor comes; also to teach women how best to co-operate with the doctor in the

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sick-room, by carrying out his instructions systematically; and by proper attention to matters of ventilation and sanitation to add to the comfort of the patient, and increase his chances of recovery.

The endeavour of the association has been not to *rival*, but to *aid* the doctor in his noble work; the best proof that it has partially succeeded in this is the active and earnest co-operation of the medical profession throughout the length and breadth of the land. Distinguished medical men are to be seen taking a prominent part at the various ambulance meetings held at our centres of industry and population, while many spend their valuable time in giving gratuitous lectures to those who cannot afford to pay the customary attendance fees.

Although the information imparted in the lectures is useful to high and low, rich and poor, yet experience has shown that to certain classes it is of special importance. Among such I would place the police, railway servants, and working-men in colliery and other industrial districts. The knowledge of what to do in the sick-room ought to form part of the education of every woman, and is of the first importance to those who have, or look forward to, the responsibilities of family life.

It is very satisfactory to find that the recent growth of the movement has been most rapid among those classes of the population to whom it has been found most useful. Of the 200 centres formed in different parts of the United Kingdom, every one with its own committee and officers, many are found in the midst of our crowded industrial populations. Among the collieries in which such organizations exist, I may mention Blackwall, Claycross, the Eckington Collieries, Grassmore, Littleshall, South Shields, Tibshelf, and Darlington, while a complete system of instruction is being carried out in the North Wales collieries at Ffrwd, Plas-Power, Wrexham, and Wynnstay.

Very few of those who are not personally acquainted with the mining districts have any idea of the number of accidents which happen, I may say, day by day. In a return furnished to Surgeon-Major Hutton by the Secretary of the Miners' Association, it is stated with reference to the Cleveland and North Yorkshire iron and mining districts, that during the year 1883 there were 847 non-fatal and 29 fatal accidents, making a total of 876 in those districts alone. The report states: "If we make a very moderate calculation in relation to the accidents which have not been reported, we arrive at the startling fact that one person has been injured or killed during 1883 for every eight employed in and about the Cleveland Mines." Again, it is reported that out of 224,000 members belonging to the various

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societies in our mining districts, 44,579 cases of injuries were relieved during 1883; while at one of the recent St. John Ambulance meetings at Wigan, Lord Crawford and Balcarres stated that there could be no doubt that on the average no fewer than 100,000 accidents, large and small, occurred throughout the mining districts of this country every year.

Want of space will not allow me to discuss the subject from an economic point of view, but I believe I could prove that the employers of labour would be large gainers by encouraging ambulance classes among their employés, especially since the passing of the Employers' Liability Act. As an example let me quote the case of a firm which paid over £1,300 compensation for injuries received by their workmen during 1883. Last winter, however, they introduced ambulance classes among their men, and formed a little depôt of ambulance material on their works. The secretary, in preparing the report of these ambulance classes, called the attention of the committee to the remarkable diminution in the number of injured men coming forward for compensation, thus proving that in that case, at least, it had been well worth the employers' while to educate their men in "First Aid to the injured."

As instances of the valuable aid rendered by certificated pupils in the collieries, I will quote a few cases reported from the coal districts. The following entries are made in the Ambulance Report Book of the Eckington Collieries, Derbyshire:—

Case.	*Surgeon Jones' Report.*
(1). Large lacerated wound in back.	"This patient, although he subsequently succumbed to his injuries, was most comfortably removed, and his sufferings were much alleviated."
(2). Fractured base of skull.	"Found this man comfortably settled in bed."
(3). Face burned by explosion of powder.	"These burns were well dressed with oiled lint."
(4). Fractured thigh.	"Most satisfactorily put up with splints."
(5). Fractured ribs and bruised shoulder.	"This was a very serious case of fractured ribs and wound of lung. Sent home very comfortable in litter, with broad roller bandage round chest."

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The following cases are reported from the Tibshelf Colliery:

Nature of injuries.	*Report.*
(1). Wrist run over and artery divided.	Sent to Chesterfield Hospital without removal of improvised tourniquet.
(2). Ankle cut by a scythe.	Tourniquet applied to femoral artery, and sent home.
(3). Run over by a railway waggon.	Tourniquet applied to femoral artery, and sent to Chesterfield Hospital, without its being found necessary to alter the tourniquet.

In the Heavy Woollen District, including Dewsbury, Batley, &c., classes have been formed to provide against the many accidents which occur, while the operatives engaged in iron and other industries have the opportunity of passing through the course at such centres as Middlesborough, Leeds, Keighley, Bradford, Sheffield, and Manchester. It is known that many of our sailors go to sea in ships which carry no medical man; accidents will, and do often happen on board; how valuable in such cases is a little knowledge of what to do. In view of extending the movement among our merchant marine, classes have been formed at Portsmouth, Greenwich, West Hartlepool, Liverpool, Grimsby, Newcastle, and other seaports. At the same time large classes have been formed at some of the London and other Docks, and the brewers of Burton-on-Trent and in the East of London have shewn a good example in encouraging the formation of classes among their numerous employés.

While alluding to the work done by these various centres, I must not omit to thank those who have so ably and successfully carried out the ambulance movement in this city (Dublin). No fewer than 3,256 persons have been passed through the course, and 128 men and women have, by a system of annual re-examination, qualified for, and obtained, medallions.

With regard to the police, in the London metropolitan district alone nearly 1,700 police have gone through the course, and so important is the instruction considered, that H.M. Government grant an annual subsidy towards defraying the expenses of the police classes at Scotland Yard and elsewhere. The officers and men of this force, of all grades, volunteer in large numbers to attend the lectures. Truly they deserve our hearty thanks when we remember the frequency of accidents in our streets, and how the duty of conveying the unfortunate sufferer to his

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home or hospital usually devolves upon the police. Let me quote one or two cases at random to show the good work they have done :—

Only a few months ago Police-Constable Pearson, a certificated pupil, had found a man suffering from hæmorrhage, caused by the bursting of a varicose vein. Pearson's prompt action in arresting the bleeding and conveying the man to the hospital probably saved that valuable life. I am glad to add that Dr. Urwick, the acting house surgeon of Westminster Hospital, testified by letter to these good services rendered. Again, in May last a Local Inspector of Police at Liverpool found a sailor lying in a low suburb with his right leg fractured. Procuring some pieces of wood, the officer extemporized a splint, bandaged the limb, and conveyed the patient to the Royal South Hospital, receiving the thanks and compliments of Dr. Allan, the Resident Medical Officer. In January last at Liverpool, an old man was run over by a cart and his leg was badly fractured. A police constable, who had recently passed through the course, applied splints and bandages, and awaited the arrival of a doctor from the Northern Hospital, who highly complimented the policeman, and said that, had it not been for his ready treatment, death might have ensued.

Many of you remember the fatal railway accident which occurred between Preston and Wigan last year. At the scene of accident, and in the conveyance of the injured to Wigan and Manchester, many of the certificated pupils of the Association were enabled to render valuable services. A local paper tells us "The excellent system of the St. John Ambulance Association was conspicuously serviceable. Mr. Tongue, the Assistant District Superintendent, Mr. Taberner, the Wigan Stationmaster, and several of those actively assisting, are holders of the certificate of the Association, and in directing those who were not so qualified to render aid to the injured, carrying and lifting the injured, utilizing litters and stretchers of the Wigan Centre, they repeatedly elicited very hearty praise from the surgeons." I quote this case as one specially interesting, from the fact that the police, the railway officials, and several Wigan workmen, were all at the same time putting to such good use the knowledge gained at the lectures. Indeed, the number of instances in which efficient first aid is rendered are of such frequent occurrence, that scarcely a week passes without one or more authenticated cases being reported.

The movement has not been confined to the United Kingdom. That which has been found so useful here, where we have doctors within, at most, an hour or two's call, is considered by thinking men all-important in countries where hours and

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perhaps days may elapse before qualified medical aid can be secured. Some practical friends in Australia have accordingly initiated classes on a large scale in two districts of New South Wales, while in Bombay last year I had the gratification of initiating the formation of centres in India, with a committee, under the presidency of the Governor of Bombay, Sir James Fergusson, and comprising the leading Europeans and Hindoo, Mussulman, and Parsee natives. Contrary to the foreboding of some experienced Anglo-Indians, that fine body of men the Mahratti police were the first to volunteer passing through the course, and took the keenest interest in the work. Can it be doubted but that instruction such as this, instruction directed towards the saving of human life, and the relief of physical suffering, can have any but a humanizing and civilizing influence upon the native population, instilling into them those qualities of helping the weak, and relieving the suffering, which it is one of the main objects of our Christianity to impart. Endeavours will be made to extend the knowledge among the female members of native families, who, owing to custom or prejudice, have been brought up in entire ignorance of the first principles of health, and of the most elementary rules of home nursing.

To turn to the West Indies, see how cordially Lady Brassey, in her "Sunbeam," was lately received while planting and extending St. John Ambulance work among the islands—a ray of light indeed to those who were in so much darkness there. After starting the movement in Madeira, Lady Brassey visited Trinidad, where the governor and leading colonial authorities at once took up the movement warmly, and a crowded meeting was held. At La Guayra and Caracass the movement was introduced under the auspices of the British Minister. Jamaica was visited with a like object, and then passing on to Nassau, New Providence, Lady Brassey had the satisfaction of initiating the work with an enthusiastic meeting under the presidency of the Governor, Sir C. Lee. Similar success attended the visit to Hamilton, Bermuda, and Lady Brassey states that she has most satisfactory reports from other islands and places, including St. Vincent, Barbadoes, Basseterre, St. Kitts, and from British Guiana, which she was unable to visit, but with which she had been in correspondence.

Our American cousins have not been slow in recognising the good practical results of the classes, and we hear of a large and extending system of lectures based on an organisation similar to that of the St. John Ambulance Association.

Mainly through the exertions of Mr. John Furley, Deputy Chairman of the Association, an important advance has of late

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been made in the matter of improved stretchers, litters, and ambulance waggons for the removal of sick and injured persons. I refer especially to the "Furley" stretcher, with or without telescopic handles, and the "Ashford" two-wheeled litter, with which many of our police-stations are provided. The "Lowmoor" Jacket has been introduced, which is intended to meet the difficulty of removing injured men from those coal pits in which the cages are too small to receive a stretcher in a horizontal position. By its means a man with even a fractured thigh can be put into a perpendicular position, and thus drawn through a narrow shaft. Special ambulance hampers have been arranged, and are provided for factories, collieries, mines, and railway purposes.

One of the Furley waggons has lately been established in connection with the Northern Hospital of Liverpool, and is the first vehicle for accidents worked in this country on the American principle. The station where it is kept is in telephonic communication with all the police stations in Liverpool. American clip harness is used, and the average time taken to get the carriages equipped is two minutes. Nearly 500 calls were made for this waggon during the first eleven months of its installation. Though we have no such complete organization in London (except for infectious cases under the Metropolitan Asylums Board) yet the St. John Ambulance Association has provided wheeled litters at most of the principal police stations, which are frequently used by the members of that force, and are also at the disposition of the public in case of accidents.

Another important branch of work on which the St. John Ambulance Association has recently been engaged, is the formation of ambulance corps for the removal of sick and injured persons (excluding infectious cases), for long or short distances. In the former case, it is a most important point to secure, as far as possible, uniformity of design in the ambulance material, so that any stretcher may fit any ambulance carriage or wheeled litter. As an instance of this, I quote a passage from Mr. Furley's paper, read at the Health Exhibition Conference in June last:—

"A few weeks ago an invalid at Cannes was placed in a compact bed on an 'Ashford' litter, that had been purchased of the St. John Ambulance Association for use in that town, and taken to the railway station. Here he was lifted off, still on the same stretcher, and put into a saloon carriage, and thus brought without change to Boulogne. Patient and stretcher were then put on board a steamboat, and at Folkestone again placed on the railroad. Two members of the Metropolitan Ambulance Corps of the St. John Ambulance Association met

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the train at Charing Cross with a horse-carriage, and in this manner the invalid was transported, literally in a bed, from the shores of the Mediterranean to his home in London."

A well-organised ambulance corps has been established in the metropolis with a waggon and all material necessary for the work. Removals of patients are effected at a regular scale of fees, reduced to a nominal amount in cases of persons with small means, and convenient arrangements are made with the railway companies and others to ensure the greatest amount of comfort to the patients during transport. The case which I have quoted of a journey from Cannes to London is an example of what can be done by a properly-organized system. Local ambulance corps have been formed at Leicester, Leamington, Bridgham, in Yorkshire, and at various places in Kent. There is every prospect of this useful branch of the movement extending throughout the length and breadth of the land.

The Association is still endeavouring to establish ambulance centres at all the principal termini and junctions of the different railway companies, in connection with classes to be held at regular intervals among the employés. At such centres it is proposed to keep a depôt of stores ready at hand, in case of accidents. These proposals are being seriously considered by the directors of several companies, and will no doubt lead to some systematic organization being established, either under their direct control or under the Association. In fact, classes have been already held in connection with five of the leading companies. As an example of how useful such classes may be, I quote a recent case of eight men who were suffocated by poisonous gas in the hold of the s.s. "Cardiganshire," lying in the docks of the N. E. Ry. Co., at Middlesborough. They were extricated with difficulty and lifted on deck, where they lay apparently dead. Doctors were sent for, but, being early in the morning, it was an hour before they arrived; in the meantime some of the employés restored animation by the means which they had learnt at the Ambulance classes. The lives of the eight men were thus saved.

With regard to home nursing, it is unnecessary for me to remind you how impossible it is to create a professional nurse by the instruction given in five lectures. No such thing is aimed at, but I wish to impress upon you that a great deal of useful information—information that every educated woman should possess—can be taught in those five lectures, especially if the pupil has already passed through the first aid course. I have been repeatedly informed by doctors of the prevailing ignorance of otherwise well-educated women as to some of the most ordinary duties of home-nursing and the commonest

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precautions to be taken in the sick room. The doctor has no time to educate the nurse while he is attending to the patient, and remember that intelligent nursing is often as necessary to the recovery of the patient as skilful medical advice. Again, looking upon the matter from another point of view, how invaluable a privilege it is to be able to add to the comfort of a sufferer, perhaps near and dear to one, at a time when such help is most wanted, most appreciated.

It is said that the instinct of self-preservation is all powerful, but there seems to be another at least as strong—the instinct of preserving others. How often do we hear of men risking their own lives in trying to save those of others—perhaps perfect strangers. A week scarcely passes but we hear or read of men risking death by drowning, burning, or by suffocation in the pits, while endeavouring to help their fellow creatures from danger. We see the same strong instinct in our sisters. Have you ever witnessed the savage havoc of war or the pitiless scourge of an epidemic? There is no want of women ready to nurse the victims though heavy risks have often to be run. During the Turco-Russian War fifteen out of the forty sisters of charity engaged in nursing in the military hospitals at Constantinople succumbed through exhaustion and disease; a strange reward for such devotion! I might quote many other instances in which women have forgotten all idea of self-preservation in their eagerness to relieve the sufferings of others.

With such instincts strongly implanted in us, is it strange that the work of the St. John Ambulance Association should have taken root so deeply among the masses and brought forth fruit so abundantly? Whatever and whenever the sickness or accident may be, of stout hearts and willing hands we have plenty. What is wanted is a little more knowledge to enable those willing hands to do well the good work they may undertake. That knowledge it is the aim and ambition of the Association to impart.

Having given you a short and very imperfect account of the progress made by the St. John Ambulance Association in ambulance work for *non-infectious* cases, I propose to deal with a still more difficult, and, I may say, gigantic task, in connection with *infectious* cases recently undertaken by the ambulance department of the Metropolitan Asylums Board, and carried out to a highly successful issue. It may not be known to many of you that the Metropolitan Asylums Board has, among its other duties, that of the transport to hospitals, and treatment of large numbers of sufferers from small-pox and other epidemics, which commit such havoc among the crowded population of our Metropolis. It is with these transport and ambulance arrangements

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that we have to do to-day, and, thanks to the large resources at its command, and the Parliamentary powers at its disposal, the Board has organized the largest system on record of ambulance road and river transport in connection with its floating hospitals and convalescent camps.

The object of the new system is to prevent the concentration of any considerable number of infectious cases in the London hospitals. As many as possible of these patients are moved by detachments from the hospitals, or singly from their own homes, to special ambulance wharves, and are thence taken down the river by the Board's ambulance steamers to the floating hospital or the convalescent camp.

For ambulance purposes London is divided into three districts, the East, West, and South-East, in which are respectively established three ambulance stations, in direct telephonic communication with the central office of the Board in Norfolk Street, Strand. Every ambulance station contains coach-house, stables, kitchen, dormitories, disinfecting rooms, and other offices adapted to the wants of the resident staff. The greatest precautions are observed to prevent infection during the frequent passage of the ambulance waggons through crowded streets. Every ambulance carriage is thoroughly disinfected at the hospital to which it has brought a patient *before leaving that hospital*, and proper precautions are taken in the case of any of the staff who may be brought into contact with patients.

The ambulance carriages, some forty in number, are distributed between the three ambulance stations. Some are reserved for fever cases, others for small-pox. These latter may be divided into two classes; a large size for four or five patients and nurse, used for transferring detachments of patients from the hospitals to the ambulance wharves on their way to the floating hospital; and a small size, used for conveying one or two cases from their homes to the hospitals or wharves. These waggons are specially constructed, the side windows do not open low down, and ventilation is effected as far as possible from above. Experiments are being carried out, with every prospect of success, to purify the vitiated air escaping from the interior of the waggon during its journey by means of a special disinfecting arrangement in connection with an exhaust cowl.

In order to show the amount of work which is done by these road ambulances during an epidemic, I will take as an example the week ending July 5 last, when the small-pox epidemic in London was decidedly on the decrease. The number of removals of small-pox patients was as follows:—

Acute cases, conveyed *from their homes* to hospitals and wharves in London 241

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Acute and convalescent cases *from hospitals* to wharves in London...	99
Convalescing cases from the Floating Hospital (*Long Reach Pier*) to the Convalescent Camp	162
Received and discharged patients reconveyed from the camp to Long Reach Pier	126
Recovered and discharged from the wharves to their homes in London	126
Recovered and discharged from London hospitals to their homes	17
Total during week	771

During the same week there were 61 fever cases removed, making a total of 832 removals in all by the ambulance waggons.

We now come to the ambulance steamers, two of which, the "Red Cross" and "Maltese Cross," are specially constructed for the conveyance of patients from London down the river to the camp and floating hospitals; a third, the "Albert Victor," though arranged to carry acute and other cases on an emergency, is intended to carry back to the wharves in London, *en route* to their homes, the recovered and disinfected patients from the Floating Hospital and Camp. The fourth steamer, the "Marguerite," which is much smaller, is used exclusively for the conveyance of hospital ships' committee of the board, and for the nurses and other members of the staff; also for the conveyance and reconveyance of any relations of the patients who may have been summoned to their bedsides.

The "Red Cross" and "Maltese Cross" were designed by the naval architect, Mr. Adam Miller. Special care has been taken to provide for proper ventilation, and no detail is wanting which might add to the comfort of the patients on their journey. Those who are too weak to walk, are lifted from the ambulance waggons on their stretchers, and carried direct on board, where they are under the same conditions as if in a hospital. A doctor and nurse are told off for each steamer, and accompany the patient during the journey.

The dimensions and speed of these ambulance steamers are as follows:—The "Red Cross" is 105 ft. in length, with a beam of 16 ft. 6 in.; depth 6 ft. 6 in., and she draws 4 ft. 6 in. She can carry 16 patients, lying down, and 150 sitting. Speed about 10 knots. The "Maltese Cross," only recently finished, is 132 ft. long and 16 ft. 6 in. broad, with a depth of 7 ft. 6 in., but only draws 3 ft. of water. She can carry 36 patients, lying down, and 200 sitting, with a speed of 10 knots. Her

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lighter draught will enable her to go up the river to Wandsworth to take away patients at all states of the tide from the new ambulance wharf to be constructed there.

The "Albert Victor" is of nearly the same dimensions as the "Maltese Cross," and can carry 20 patients, lying down, and 150 sitting, with a speed of 12 knots; but she could carry a much larger number of recovered patients, for whose accommodation she is mainly intended. The "Marguerite" is a fast little paddle-wheel steamer, 73 ft. long, and 10 ft. 1 in. broad, drawing 2 ft. 4 in., and can carry 30 persons, with a speed of 12 knots.

Taking the same week which I selected before, namely, that ending July 5th, as a fair example of the work done during an ordinary epidemic, I find that the ambulance steamers conveyed from London 129 acute recumbent cases, and 112 not acute and convalescent cases, making a total of 241, while 126 recovered patients were re-conveyed from the hospital ships and Camp Pier back to London; thus the total removals in the week amounted to 367. In many weeks this total was far exceeded.

As the ordinary London wharves could not be used for embarking patients on to the ambulance steamers, the Metropolitan Asylums Board had to select and purchase wharves with landing stages of their own. The sites of the three London wharves which were found necessary were selected as being in the most accessible position with respect to the hospitals and the population of the various districts in London.

During an epidemic the ambulance waggons would, as it were, converge on the wharves, and, therefore, an important consideration in choosing the sites was that these wharves should be approached by roads, where there was not likely to be any block in the traffic causing delay to the ambulance waggons, and keeping them standing long in crowded thoroughfares. Finally three sites were selected. One on the Middlesex shore at Wandsworth, destined to receive patients from the North-Western Hospital at Hampstead, distance seven miles, and the Western Hospital at Fulham, distance one and a quarter miles. The second wharf is Acorn Wharf, Rotherhithe, on the Surrey shore, which accommodates the South-Western Hospital at Stockwell and the South-Eastern Hospital at Deptford, situated at distances of four miles and three-quarters and two miles respectively. The third wharf is Brown's Wharf, Blackwall, on the Middlesex shore, selected for the accommodation of the South-Eastern Hospital and Plaistow Hospital, each about four miles off. A fourth wharf, with pier, has been constructed opposite the Floating Hospital in Long Reach, some twenty miles down the Thames below London Bridge, called Long

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Reach Wharf. It is that where patients destined for the Convalescent Camp Hospital, four miles off, are disembarked.

The ambulance wharves will all be furnished with piers running out to a floating landing-stage, so that the patients can be embarked and disembarked at all states of the tide. These piers will be covered in, so that the patients may not run any risks while being conveyed along them during rough weather. The Wandsworth wharf has not yet been commenced, but of the others, the Long Reach wharf and pier have been in use for some time, and also Acorn Wharf, while Brown's Wharf is still in course of construction.

This paper would, perhaps, be incomplete without some description of the Floating Hospital and the Camp Convalescent Hospital, so often referred to above.

The Floating Hospital consists of three ships, the "Atlas," "Endymion," and "Castalia," moored one behind the other in the order named. The "Atlas" is a large three decker man-of-war, lent to the Board by the Admiralty, and is 284 ft. long and 50 ft. broad. A large hatchway, 24 ft. by 11 ft. 6 in. has been cut through the upper and lower decks in the centre of the ship, and forms a most efficient ventilating shaft for the egress of the impure air from the wards, while the fresh air is introduced through a long series of windows replacing the ports. Owing to the lowness of the wards this arrangement was found necessary. The patients are distributed in three long wards, accommodating in all 150, but, on an emergency, 200 patients could be treated on board. The "Castalia" is a twin ship, which, having been unsuccessful as a Channel passenger boat, has been bought by the Metropolitan Asylums Board. She is an object of special interest to those who are watching the progress of sanitary science, on account of the peculiar *échelon* arrangement of the five detached huts or wards on the capacious upper deck—an arrangement for which I was responsible. Of these huts the two end ones are, in outside measurement, 50 ft. by 28 ft., and the remaining three 54 ft. by 20 ft. The lower deck is divided by the iron bulkheads of the ship into five wards, of which the two end ones are semicircular, with a radius of about 30 ft., and the remaining three rectangular, and measuring about 60 ft. by 30 ft.

There are several advantages in this échelon arrangement of detached wards. It can be seen at a glance that the end windows in the long sides of the ward, instead of looking directly into the windows of the adjoining ward, which they would do if the huts were built at right angles to the length of the ship, look out crossways or diagonally on the open river, and thus a maximum amount of cross ventilation is secured. Again, the

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fact of these windows looking edgeways up and down the river, gives a far more cheerful outlook to the patients than if they looked direct into the walls or windows of the adjoining huts.

The ventilation of these detached huts was a very simple matter, but that of the wards in the lower deck caused much trouble and expense, as the only windows in those wards were in the short sides; and it is highly undesirable, especially in the case of infectious disease, that the current of air should flow from one end of a long ward to another. Artificial means had therefore to be adopted; two large apertures were made in the roof of every ward, and funnels carried up, surmounted by large Boyle's exhaust cowls. These effectually draw up the vitiated air, while the fresh air is introduced by means of apertures near the floor, fitted with a series of hot-water pipes, which have the effect of taking the chill off the air before it enters the ward. In case of a dead calm, or very slight motion of the outside air, when the exhaust cowls might not act, a blast arrangement has been fitted to the ventilating shafts to create an artificial current of air. "The "Castalia" could accommodate, on an emergency, 200 patients.

The "Endymion" is a frigate lent by the Admiralty, 277 ft. long, by 42 ft. broad, and is moored between, and connected by gangways fore and aft with, the two hospital ships. She is used as an administration ship on which the nurses and other employés, about 130 in all, live when off duty; and here the office, cooking, and other administration work is carried on. The warming of all three ships is effected by hot water pipes, and estimates are now being prepared for lighting by incandescent electric lamps. The washing for this large establishment is done in two steam laundries, one for the patients and the other for the staff, erected on the south shore of the river opposite the ships. The Thames water not being considered sufficiently pure for this purpose, water is brought in pipes from the Kent Waterworks, a distance of four miles.

The Camp Convalescent Hospitals, to which are also sent some of the mild cases, are situated on the slopes of the Darenth Hills about four miles south of the ships, and at a distance of 160 yards from each other. The sleeping tents in these camps are pitched 50 feet from each other in double rows, with an interval of 80 feet between the rows. They are not pitched quite regularly, being sometimes arranged in échelon, or in other positions so as to take advantage of the undulations of the ground. The only wooden structures are the kitchens, boiler house, bath house, and the scullery.

The sizes of the tents are as follows:—Ordinary sleeping tents, for twenty beds, 50 ft. by 25 ft.; day tents, 60 ft. by

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25 ft.; infirmary tents, for sixteen beds, 80 ft. by 25 ft. The lighting and cooking is done by gas furnished by the neighbouring gas works in connection with the Darenth Asylum; the tents are warmed when necessary by a system of hot-water pipes, by which means the temperature can be kept nearly uniform. At one time during the recent epidemic, there were over 1,000 patients in the camps.

Now that the small-pox epidemic is over, these camps will be closed, and the tents, after being thoroughly disinfected, can be stored away ready for use on some future occasion. In this matter a camp hospital has a great advantage over a permanent structure, while the result of the treatment of patients under canvas is reported to be highly satisfactory.

The new system which I have described to you is a decided advance on what has gone before; some of us remember how people suffering from small-pox have been carried through the streets in ordinary cabs, not unfrequently accompanied by members of their family. We have heard how a parish hospital waggon for infectious cases was kept in the same shed with the bread waggon for out-door relief and the guardians' carriage; how, in another case, it was kept alongside an ordinary invalid chair; while it is not so many years ago since a cab drove up to a London small-pox hospital with the driver and patient both intoxicated.

The work of the new ambulance system of the Metropolitan Asylums Board during the late epidemic may be briefly summarised as follows:—Between 200 and 300 patients a week were removed from the metroplitan area by road and river ambulances, with the result that a very large proportion of the small-pox patients, instead of filling the London hospitals, were treated in the country, twenty miles from the metropolis; at the same time the conditions of the Darenth camp were highly favourable to the convalescents treated there. Many authorities consider that the speedy removal of so many infected persons from our crowded metropolis had a great deal to do with the rapid and somewhat unexpected termination of the recent small-pox epidemic.

I beg to thank the President and Committee of this Sanitary Congress for the high honour which they have done me in inviting me to address you to-day on this great subject of Ambulance Work, to which, as a member of the St. John Ambulance Association and of the Metropolitan Asylums Board, I have devoted no little time and attention. It is truly a subject of national importance, for it affects the health, and therefore the wealth and happiness of thousands of the inhabitants of this great country. With regard to the St. John ambulance work, I trust that the other towns and districts of Ireland will follow the good lead which Dublin has given them;

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while with regard to the Metropolitan Asylums Board ambulance organisation during epidemics, I hope that the results of its recent experience placed before you to-day may be of some practical use in the event of any outbreak of an epidemic in this country. Pray God you may long be spared from such a calamity.

Let me add that the extension of ambulance work in Ireland, a country to which I am attached by so many ties of blood and friendship, is of special interest to me; I feel moreover that this work is one well suited to the warm hearts and sympathies of Irishmen.

In conclusion I cannot do better than quote the words of that distinguished surgeon Sir James Paget, spoken at a recent conference at the Health Exhibition. Referring to ambulance work in general, he said, "Few things indeed were there in which charity could better exercise itself than in this. There was ambulance work, or first aid, in that incident which led to the giving of the command most general and most unconditional, where a man on finding another wounded by the roadside poured in oil and wine, and set him on his own beast and took him to the inn. That was an admirable example of what ambulance work might be, and the command was '*Go thou and do likewise.*'"

Dr. J. F. J. Sykes (London), Senior Secretary of the Section, said the method adopted in London for procuring an ambulance was to telephone or telegraph to the head office in Norfolk Street, Strand, and the head office telegraphed to the sub-office nearest the place where the ambulance was required; so that in the course of an hour the patient was taken by the ambulance to the wharf, put on board the steamer and taken down the river. The *river-carriage* of the patients was the great point of innovation, as it minimised the spread of infection, and facilitated transport to a greater distance. Whether the Hospital happened to be in mid river or on the bank mattered very little, provided it was isolated. He had never seen it acknowledged that Dr. James Stevenson, Medical Officer of Health for St. Pancras, was the first to investigate and unmask the horrible system of infectious diseases removal, and that he published a pamphlet which pointed out the necessity for an improved ambulance system. The arrangements proposed for the reception of cholera patients last summer in London, although unmentioned, were worthy of description.

Dr. T. W. Grimshaw (President of the Section), was afraid they could not expect much to be done in Dublin. The difficulty was insurmountable in the way of transit of the sick by the river, as the river could only be used two hours each day for steamer traffic under the bridges. Dublin was much in need of a proper ambulance system; he was sorry to say a great number of street cabs were still used for carrying infectious cases.

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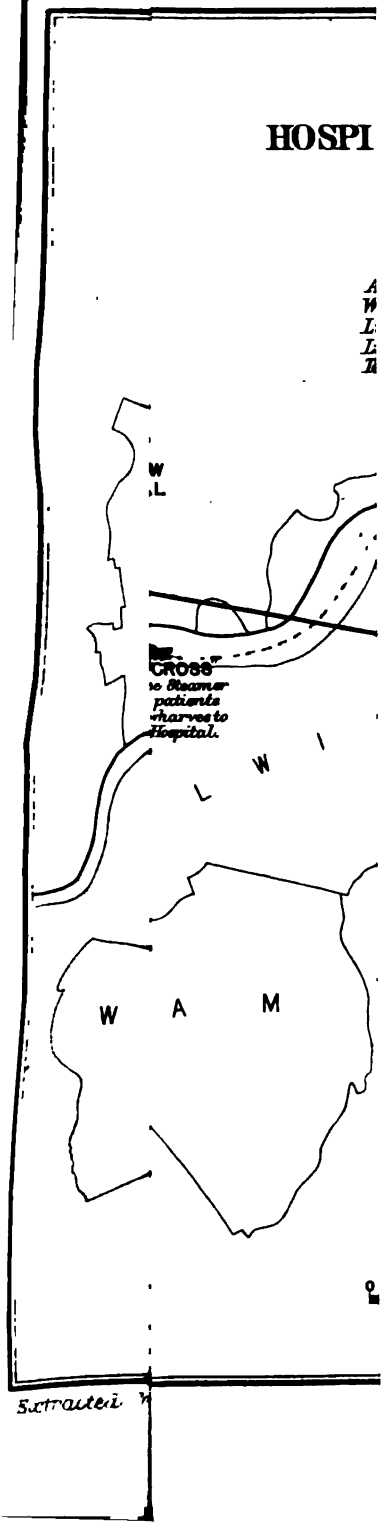

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SECTION II.

ENGINEERING AND ARCHITECTURE.

ADDRESS

By Charles P. Cotton, M.Inst.C.E.

President of the Section.

The development of Sanitary Science in recent years has led to the gradual formation of what may be termed a special branch of the Engineering profession. The very earliest engineering works on record were connected with sanitation as exemplified by ancient aqueducts, the *Cloaca maxima* of Rome, &c., &c. It is, however, only within the latter half of the present century that much real attention has been paid to the science of Sanitation in its various branches, resulting, *inter alia*, in the assistance of the engineer being sought for the purpose of designing and carrying out works for providing a health-giving supply of pure water, for disposing in a satisfactory way of the filth which would otherwise accumulate wherever people are aggregated in large numbers, and for the realization of other desirable sanitary objects.

It is not only in the more pressing instances of cities and large towns that greater attention has been paid to these matters in recent times, but the awakening to the importance of the subject has become universal. The engineer is now called on to deal with a great variety of sanitary works—differing not only in kind but in magnitude—from the sewerage of a hamlet, or even of one mansion, to the complicated main drainage system of a city—from the sinking of a pump well to the construction of works on a vast scale, such as those of the Vartry, by which the city we are now meeting in is supplied with water.

Such works have been increasing in number, following good

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examples, the benefits from which are at once felt and appreciated, and doubtless to a great extent owing to the instrumentality of this Institute, the proceedings at whose annual congresses are now eagerly looked forward to, attentively watched during their progress, and subsequently discussed with the greatest interest by the public.

A great impetus was given to sanitary engineering works of a public character by the passing of the Public Health Act, 1875, and the Public Health (Ireland) Act, 1878. By these Acts sanitary authorities in England and Ireland have had important duties thrown on them, coupled with extensive powers to enable them to fulfil those duties, and—last but not least in importance—means are provided by which the funds required for carrying out the necessary works can be obtained on easy terms, both as regards the interest and the repayment of the principal.

It will not, I trust, be thought inappropriate if I take for the subject of my address to you the operation of the Public Health (Ireland) Act, 1878, in as far as it relates to engineering.

For the purposes of sanitary supervision, Ireland is divided into urban sanitary districts and rural sanitary districts, the former consisting of the larger towns, in which there are legally constituted municipal authorities, and the latter consisting of the Poor-law Unions, exempting for this purpose from each union so much of it as lies within any urban district.* No urban district can exist without a local authority, such as town commissioners, but small towns, even though they may, for other purposes, have such a local authority, may be comprised in a rural district, and be under the sanitary supervision and control of the guardians of the union acting as the rural sanitary authority.

The sanitary authorities, urban and rural, have, as I said before, many important duties thrown on them, foremost among which are some which compel them to seek the advice and assistance of the engineer, such as the improvement of the water-supply of the district, the provision of a new supply of water, proper and sufficient for public and private purposes, and the repair of all sewers belonging to them, and the construction of such new sewers as may be necessary for effectually draining their district.

The architect is concerned with other and very important provisions of the Act, such as the regulation of buildings and formation of bye-laws for that purpose, the construction of new streets, baths and wash-houses, dwellings for labourers and artizans, &c., &c.

Other provisions of the Act impose duties and confer powers

* NOTE.—A list of the urban districts is given on page 213.

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of the greatest importance as to matters which come within the province of the medical officers of health, such as the abatement of nuisances, provision and care of burial grounds, scavenging, and depôts for that purpose, mortuaries, places for *post-mortem* examinations, slaughter-houses, markets, disinfecting chambers, &c., &c.

Lastly, the Act, directly, or indirectly through the operation of other Acts incorporated with it, provides for matters which *primâ facie*, are less immediately connected with the health of the public, such as town halls, public clocks, town parks, &c., &c.

I propose to confine my remarks chiefly to the operation of the Act in respect of sewerage and sewage disposal and water-supplies.

Since the power of sanctioning loans for sanitary purposes was given to the Local Government Board for Ireland, loans for various purposes under this Act have been sanctioned to a large amount. In the nine years ending March, 1884, the total amount of such loans was £1,206,419 (see Annual Report, 1884). Of this about £700,000 was sanctioned for water-works and £230,000 for sewerage works. Loans to the extent of over £100,000 have been sanctioned for paving streets and flagging footpaths; the balance consists of loans for labourers' and artizans' dwellings, new streets in Dublin, town halls, cemeteries, baths and wash-houses, scavenging, &c.

The time of repayment of money borrowed under this Act cannot exceed sixty years, but if the loan (as is the all but universal custom) is sought to be obtained from the Commissioners of Public Works in Ireland, the term cannot be extended beyond fifty years, and in determining the time when such a loan is repayable regard must be had to the probable duration and continuing utility of the works in respect of which the loan is required.

The cities and large towns have all, as a matter of necessity, had to make provision of a more or less complete kind for a supply of water for public and domestic purposes, but many of the smaller towns are still badly in want of improvement in this respect; the sanitary authorities not being pressed on the subject, and being often in ignorance of the expense to which they may be led if they once embark on sanitary improvements, are apathetic or unwilling to do anything by which the rates might be raised.

Of the large works for the supply of the cities and principal towns I propose to say but little, descriptions of many of them will be found among the proceedings of the Institution of Civil Engineers, and of the Institution of Civil Engineers of Ireland, and of kindred societies, but I think some remarks as to what

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has been done in cases of less important towns may not be without their use.

As a rule the supplies of water to the cities and larger towns have been provided under powers conferred by private Acts of Parliament, but since the introduction of the Act of 1878 several urban authorities of towns of importance have availed themselves of the machinery therein provided for obtaining by provisional orders the powers of purchasing lands and water under the Lands' Clauses Acts otherwise than by agreement. These powers of compulsory purchase are identical with those conferred by a private act, and are obtainable at a very trifling cost compared with that of a private act. In some cases where private acts containing borrowing powers have been obtained for water works the sanitary authorities have elected to borrow, not under their own Acts, but from the Commissioners of Public Works under the Act of 1878. Loans have been sanctioned in this way for the water-works now in progress for the supply of the town of Sligo and the township of Rathmines.

Although there has been a great improvement in the water supply to towns in Ireland generally, there are still cases of important towns which are badly in want of new supplies or considerable improvement of the existing supplies.

There are cases where by a spasmodic awakening to the fact that a supply of pure water is desirable the Sanitary Authorities have commenced the proceedings for obtaining the requisite powers of acquiring the property rights, and have even acquired them and obtained sanction to a loan for defraying the expenses of the works, and then from some cause or other have allowed the powers to lapse and the project to be abandoned.

No doubt the proceedings of this Congress will be disseminated through the medium of the newspapers throughout the country, and will perhaps direct the attention of Sanitary Authorities of towns where deficiencies exist to the necessity for improvement, and I hope that whoever, on the next visit of the Institute to Ireland, occupies the place which I have now the honour to fill, may be able to point to a marked improvement in this respect.

The Sanitary Authorities of the smaller towns where deficiencies admittedly exist are frequently discouraged by the fancied, because unknown, extent of the responsibility they might assume, and expenses they might be led into if once they embarked on such an enterprise as a "water-works scheme." Probably they have heard rumours, and exaggerated rumours, of thousands spent on Parliamentary contests and of expenditure mounting up until the original estimate was, so to say, *nowhere*, and they decline even to discuss the question.

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It may encourage the authorities of such towns to have some information as to what has been done in cases similar to their own, and to which they can refer.

It is usual to say that engineers' estimates are always exceeded, but my experience is that a sanitary authority placing themselves in the hands of a competent engineer, may safely rely on the estimates as far as the engineer is concerned, the elements of uncertainty, and the invariable origin of supplemental loans for water-works, are the cost of the land and water and water-rights, and the law costs. I advise engineers not to estimate for these items, but to recommend the sanitary authorities to employ an experienced valuator to inform them as to the probable cost of the former, and to refer to their solicitor to inform them as to the probable amount of the latter. The mistakes, if any there be, will then fall on the right shoulders.

I have had printed a list of some of the towns in Ireland supplied, or in course of being supplied, with water under the Act of 1878, which towns have been selected as embracing ordinary cases, and you will there find in each case the population, the annual valuation (of the *town* if it be an *urban* district, and of the *area of charge* if it be a *rural* district), and the amount of loans sanctioned for a water-supply in each case, and I have added the ratios of the loan to the valuation, of the loan to the population, and of the valuation to the population.

These towns may be grouped into the following classes :—

1st. Towns in which the annual valuation is large compared with the population. These are all towns of the better class of houses, in which a large proportion of the houses are or will be connected with the mains.

2nd. Towns in which but a small proportion of the houses are or will be connected, and in which the consumption of water will be less than in the first class.

3rd. Small towns and villages, in which the supply is given almost exclusively by fountains.

In the urban towns of the first class, with populations of from 2,000 upwards, the cost of the water-works is from £2 to £3 and more per head, but does not exceed the annual valuation.

In the urban towns of the second class the expense of the waterworks has been, or will be, under £2 for each resident, but exceeds one year's valuation.

In the cases of towns that are in rural districts a separate area of charge has been assigned to each, so that a comparison between the cost of the water supply and the valuation only shows the amount of taxation which the districts have to bear in each case, as assigned at the discretion of the Guardians with

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the approval of the Local Government Board. In some cases no comparison can be drawn, as the expenses are charged on different districts in different proportions, but where there is no such differential rating the cost of the water-works is on an average two-thirds of the annual valuation of the area of charge. In some of these towns the proportion of the expenses incurred to the population is very large, as in the cases of Greystones, Enniskerry, Portrush, Lisdoonvarna, Buncrana, and Rostrevor, but these are all watering places, with a much larger population to be provided for in the summer than that resident at the time of year at which the census is taken.

The villages comprised in the third class which, of course, are all rural districts, have been supplied with water through street fountains, at a cost of about one-third of the annual valuation of the areas of charge.

In this class are some small and unpretentious works undertaken by rural sanitary authorities for the accommodation of districts where there are no aggregations of houses that could be dignified by the name of villages even. The works I allude to consist in leading the water from streams or springs not easily accessible to a fountain or fountains on the side of the public road. In the district of Little Island, for instance, in the Union of Cork, where there were no springs nor water of any kind, the guardians have brought the water from a distant stream or spring to three or four fountains at convenient points on the public road, to the great benefit of the inhabitants scattered over the district, and also remedying the great inconvenience felt through the want of drinking water for a largely-attended national school.

The Guardians of Ballyvaughan Union, in the County of Clare, have constructed several small detached works of the same kind, at little expense, but with no small benefit to the inhabitants.

How the proportion of cost to valuation affects the rates necessary to meet the expenses, if the charge is thrown wholly on the general rates, will be seen from a consideration of the conditions on which sanitary loans are now granted by Her Majesty's treasury, through the Commissioners of Public Works in Ireland. The rates of interest vary with the time when the loan is repayable—viz., for a loan for fifty years it is 4¼ per cent. per annum; for forty years, 4 per cent.; for thirty years, 3¾ per cent.; and for twenty years, 3½ per cent. All such loans must be repaid by equal half-yearly instalments of the principal with the proper interest on the then outstanding balance of principal. The annuity system, or that of repayment by equal annual payments over the entire term of the

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loan to cover repayment of principal and interest, does not now apply to sanitary loans.

The initial rate, or rate to meet the first year's instalment of principal and interest, will be the largest, and in the subsequent years the rate will be constantly diminishing. The following table shows at a glance the rates, at different periods of the terms of the loans, necessary to meet a loan of an amount equal to the valuation. For any other proportion the rates in the table are to be multiplied by the ratios of cost to valuation which I have before alluded to.

Term of loan.	Rate of Interest.	Initial rate per £	At 5 years.	At 10 years.	At 15 years.	At 20 years.	At 25 years	At 30 years.	At 35 years	At 40 years.	At 45 years	Final rate.
years	%	d.	d.	d.	d.	d.	d.	d.	d.	d.	d.	d.
50	4½	15·00	13·98	12·96	11·94	10·92	9·90	8·88	7·86	6·84	5·82	4·80
40	4	15·60	14·40	13·20	12·00	10·80	9·60	8·40	7·20	Final. 6·00	...	...
30	3¾	17·00	15·50	14·00	12·50	11·00	9·50	Final. 8·00	...	...	...	...
20	3½	20·40	18·30	16·20	14·10	Final. 12·00	...	...	...	...	...	...

Loans for water-works are usually sought for the longest term which the Commissioners of Public Works can give—*i.e.*, fifty years. It does not appear that there is any great advantage in this. The initial rate for a fifty years' loan is only a fraction less than that for a forty years' loan; and in seventeen years, before half of even the shorter term has expired, the rates to be paid for each loan are identical, and from that year onward the shorter loan has the advantage of entailing *lower*

NOTE.—Since this Address was delivered a very important alteration has been made in the rates of interest of Government Sanitary Loans. The rules now are:—

For a term of repayment, not exceeding 35 years, 3½ per cent. per annum.

For a term of repayment, exceeding 35 years, and not exceeding 40 years, 3¾ per cent. per annum.

For a term of repayment, exceeding 40 years, and not exceeding 50 years, 4 per cent. per annum.

This change does not affect loans granted before 15th May, 1885. The following Table should be substituted for that given above:—

Years.	Per cent.	1st Year.	10th Year.	15th Year.	20th Year.	25th Year.	30th Year.	35th Year.	40th Year.	45th Year.	50th Year.
		d.	d.	d.	d.	d.	d.	d.	d.	d.	d.
20	3½	20·31	16·62	14·52	12·42	...	...	...	...	...	...
30	3¾	16·31	13·88	12·48	11·08	9·68	8·28	...	...	...	...
35	3¾	15·26	13·10	12·90	10·70	9·50	8·30	7·10	...	...	...
40	3¾	15·00	12·97	11·84	10·72	9·59	8·47	7·34	6·22	...	...
50	4	14·40	12·67	11·71	10·75	9·79	8·83	7·87	6·91	5·95	4·99

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annual rates, besides being entirely wiped out in the fortieth year, when there are still ten years remaining encumbered with payments on account of the fifty years' loan.

When the loan for a water supply equals or exceeds the valuation of the premises of the district assessable in respect of it, the initial rate is seriously felt, and though it may be gladly paid by those who are directly benefited by having a supply of pure water brought to their doors or into their houses, it is no wonder that the expense is grudgingly agreed to by those ratepayers living outside the actual limits of the supply. Hence in some cases that I know of, and probably in many others that have not come to my notice, it has been found impossible to reconcile the conflicting interests so that an agreement may be come to as to the area of charge on which the loan for the works in a rural district is to be secured.

Some *urban* towns also contain a considerable extent of district that is essentially rural; in such cases, when the water is supplied under a private act, it is possible to exempt from the water-rate, wholly or partially, premises to which the mains do not extend, and thus avoid the injustice of full rating on those who are only slightly and indirectly benefitted. When such exemptions are not made a similar difficulty will be found to exist sometimes in urban districts.

The operation of the Act, as regards loans to *rural* sanitary authorities for water supplies, is this:—

When the works are of sufficient magnitude to require to be constructed out of borrowed money, the sanitary authority applies for and obtains the sanction of the Local Government Board to raise the requisite funds under Section 238.

Then under Section 232 the cost of providing and maintaining the water supply is made "special expenses," and declared to be chargeable on the contributory place or places which constitute the area of charge.

This area of charge is selected by the sanitary authority and submitted for the approval of the Local Government Board, and if they confirm it by a sealed order the area of charge so fixed becomes liable for the discharge of so much of the loan expenses as are not provided for in any other way.

As it is not usual to make any other provision, the rates on the area of charge are generally burdened with the entire charge.

Previous to the Act of 1878 an area of charge could not include portions of a townland, and as the townlands are sometimes very extensive great injustice was done by either excluding the residents in the part close to, or perhaps in, the town from any contribution to the cost of a water supply or by including

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the residents at the distant boundary of the townland. Hence arose a difficulty in practice which has been removed by allowing any portion of a townland to be included or excluded, and a more fairly adjusted area of charge constituted, by which the burden of taxation is more justly distributed.

It would not be proper to confine an area of charge to the area continuously built on, nor to extend it so as to include residents at such a distance from the town that its sanitary state is not properly of importance to them. It is not possible to lay down any general rule as to how far the indirect benefits from the improvement of the sanitary condition of a centre of population are felt, at least how far the benefit is of such an extent as to warrant a pecuniary claim on the ratepayers, and therefore the question must be considered and decided in each case independently.

That such a question is not easily decided may readily be imagined, the outside ratepayers wishing to confine the area of charge, and, with it, the liability to special sanitary rating, to the town proper as far as possible, while the ratepayers of the town desire to be relieved, by including the ratepayers living in the neighbourhood, though not actually in the town, but who constantly frequent and use the town, and cannot, or, at all events *should* not, be indifferent to its being kept in a healthy state. Hence a dead-lock sometimes arises where there is no question whatever of the *necessity* for a new or improved water supply. The difficulty would be greatly diminished if it were possible to assess differential rates in proportion to the beneficial effects of the expenditure on the urban and suburban portions of the areas of charge, or district.

The rates assessable on the area of charge are the security on which the loan is advanced, but it is not necessary that the *entire* amount required to meet the repayment of instalments of principal and interest should fall on such rates if other provision, in whole or part, can be made.

Section 66 of the Act enables the Sanitary Authority to provide funds by striking a compulsory water-rate and by entering into agreements for water-rents. The words are:—

"Where a sanitary authority supply water to any premises they may charge in respect of such supply, a water rate to be assessed at the net annual value of the premises, to be made assessed and levied in the like manner in every respect as the rate out of which the expenses incurred by such sanitary authority in the execution of this Act are defrayed; moreover, they may enter into agreements for supplying water on such terms as may be agreed on," &c., &c.

Such water-rates and water-rents would be applicable to dis-

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charging the expenses incurred in providing and maintaining a water supply, and it would be only in so far as they were insufficient for this purpose that the cost of providing and maintaining the works would become chargeable as "special expenses" and assessable over the whole district of the area of charge.

I cannot see how residents in a town who would have the great benefit of a supply of pure water to their premises could object to such water rates in addition to a smaller rate common to the whole area of charge, they would be paying the latter as members of the general public concerned in the general sanitary condition of the place, and the former as it were in payment for a luxury.

If it were understood beforehand that by putting the 66th section in force there would be practically a differential rating established, the difficulty in an area of charge being agreed on which sometimes occurs, would often be got rid of.

I am not sure that it would not be better if the striking of rates under section 66 were made compulsory on the Sanitary Authority and the proportion of them to the general rate on the area of charge, fixed.

I may refer on this matter to the evidence given before a Committee of the House of Commons on a Bill for amending the Public Health Act, 1875, which is published for sale as a blue book. On this point I may also mention the recommendations of the Commissioners appointed in 1878 to examine and report on the boundaries of the municipal towns of Ireland, and the incidence of taxation in connection with any proposed alterations. The Commissioners were of opinion that the benefits of municipal control and expenditure were in no case confined to the town proper, but extended to a certain distance outside the area continuously built on. Besides being interested in the sanitary condition of a town which they frequented and used, the suburban residents, in the opinion of the Commissioners, derived advantages from the town being well lighted and paved, and from the existence in the town of markets, schools, churches, &c., &c., of which they and their families availed themselves, for which advantages it was but fair that they should to some extent assist in providing the necessary funds. The Municipal Boundaries' Commissioners with this view recommended in the case of each municipal town that there should be an inner area consisting of the town proper liable to full rates, and an outer area subject only to half rating.

There were other recommendations in the Commissioners' Report which I need not mention, it is the proposition of differential rating that concerns the matter in hand.

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The structural works connected with the water supplies to these towns are of the ordinary kind, but the list contains some of each type of construction suited to the different circumstances that occur in practice, and I have prepared a second table in which the groups are arranged so as to show this. Where storage reservoirs are found to be necessary, the ordinary impounding embankment, with a central puddle wall, is usually adopted. In some cases, however, this has been varied, and the principal part of the dam has been constructed as a hollow or cellular concrete wall, within which the filters are self-contained. The small reservoirs at Greystones and Enniskerry have been formed in this way by Mr. Price, M.Inst.C.E., who is about to carry out the same design on a larger scale at Bandon. Mr. Strype, M.Inst.C.E., has also constructed a similar dam at Wicklow, with the addition of a clay embankment against and below the concrete structure.

Some of these water-works have a service tank near the town subsidiary to the storage reservoir, and in some the supply is furnished directly from the storage reservoir to the distributing pipes. The advantage of a service tank near the town in effecting an economy in the cost of a large main to the storage reservoir and in reducing the risk of accidents by pipes bursting is sometimes more than counterbalanced by the cost of its construction; it had to be omitted in certain cases in which it was at first proposed in order to bring the expenses within the outside limit that the Sanitary Authorities were willing to go to for the improvement of their water supplies.

Filtration has not been provided for in all cases. Generally speaking, this has been from the wish to keep down the expenses, but it has only been omitted where there was no decided reason for the water being filtered. In some cases filtration has been provided for where it might probably be omitted without real detriment to the quality of the water, though, perhaps, the appearance might be a very little improved, and it is certainly a fact that in such cases filters not properly attended to are worse than none at all, especially in the case of covered filters, such as those within the cellular concrete dams I have just referred to. Of course this remark does not refer to large water-works in charge of a special department of a corporation or urban authority, but it is different with small works, carried out and maintained by a rural sanitary authority.

As to providing for filtration or dispensing with it, the first thing to be looked at is the water-analysis and the analyst's expressed opinion on the result of it. Sometimes a decided opinion is given for or against the purity of the sample submitted, and

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sometimes the water is pronounced to be sufficiently good for a town supply *if filtered*, but more generally there is an ambiguity in the report of the analyst arising from want of information as to the *origin* of some small impurity indicated by the analysis. This takes usually the shape of an opinion to the effect that were certain constituents, named, of animal origin the water could not be pronounced good, but that they might arise from a peaty origin, in which case their presence would be of less consequence. The difference is a very important one, and it would be very desirable that the doubt should be cleared up as far as possible. I think that this is possible to some extent, in cases where the supply is taken from a stream, by taking samples not merely from one place, but from several points at intervals up the course of the stream. A comparison of the variations in the analyses, carefully considered with a map on which the nature of the surface of the different portions of the catchment area is marked, might, on the one hand, lead to a clear opinion that the slight impurity was due to a peaty origin and comparatively harmless; or, on the other hand, contamination from an animal source might be localised and eliminated.

Filtration through spongy iron has been brought prominently into notice by a paper on the Antwerp water-works, read before the Institution of Engineers, by Mr. Anderson, and by the discussion which followed. It is claimed for this process that it effects a chemical as well as a mechanical purification of the water, and it seems to be peculiarly adapted to places where the only possible source of supply is open to possible contamination of animal origin. It was proposed in one case in Ireland that filtration by this process should be adopted, and a loan would have been sanctioned for the purpose but the proposal was deferred or abandoned.

I may mention that only two loans have been sanctioned for providing filtering arrangements after the completion of the rest of the works, and no other application has been made.

In the case of such water-works as I have been considering the data on which to calculate the requisite storage capacity that should be provided for in the reservoir are seldom sufficient in kind or in detail to enable a clear deduction to be drawn. The proposal to provide a water supply is *immediately* followed by a design for the works being called for, and there are not often reliable gaugings of the streams or of the rain-fall available for the proper calculations. The error is usually found to be on the right side, and I am only aware of one case where the storage capacity provided is insufficient, and this, I was informed by the engineer, was caused by a reduction of the capacity of the reservoir proposed by him in order to reduce the first cost.

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The storage required depends also on the probable consumption, and on this point we certainly are in want of information in the case of small towns; but here, again, the error is sure to be on the right side. It would be very interesting and of considerable use if the actual consumption in the various towns could be measured and recorded. No small town, probably, has a meter on the supply, or the means of measuring it over a gauge-weir or notch, but wherever the supply comes directly from a tank, the supply to which can be shut off for a time, the measurement can be readily made. In some cases of very small supplies from springs, directly enclosed in tanks the consumption can by a little ingenuity also be estimated. The consumption during twenty-four hours is an important item in the design of the reservoir, filters, and clear water basin, or service tank; but it is also desirable that the consumption at different times of the day should be known.

A few measurements have been kindly communicated to me, and the results show, I think, the desirability of their being more generally made. In Loughrea, a town of about 3,000 inhabitants, the consumption was measured and found to be between 12 and 13 gallons daily for each person; in Belmullet (population 900), it was between 5 and 6 gallons; in Ennistymon (population 1,300), it was 5·87 gallons including a large supply to one mansion and one or two small factories; and in Miltown Malbay (population 1,400), it was only 1·8 gallons. These towns are almost entirely supplied through street fountains.

Mr. Cope, clerk of the Rathdrum Union, informs me that the consumption in the workhouse of that union in 1883 was 6·38 gallons per head daily.

Mr. Leonard, C.E., has supplied me with returns extending over some years from ten fountains in Drumcondra Township, supplied by meter; from these returns it appears that each person consumed an average quantity of 2·16 gallons daily.

In Enniskillen, Mr. Wray, C.E., kindly gave me the measurements of the hourly consumption from 6 a.m to midnight, which indicate a considerable increase of the draught at 9 a.m. which continues *without much variation* till after 8 p.m., and it would appear that one half the total consumption took more than nine hours to run off.

In making calculations for the purpose of designing waterworks any probable increase in the size of the towns should be looked to. The examination of former census returns and of evidence given at local inquiries shows but very few instances indeed of an apparent necessity of providing now for an increased consumption in the future in this country.

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Where the source of supply is a mountain stream with steep sides to the catchment area, storage has been dispensed with, as at Tralee, Killarney, and Rostrevor. At the latter place a good example of the well-known plan of automatic supply to the tank at times only when the stream is low and clear, can be seen.

In other cases where the source of the supply is a spring, or small stream from springs and not subject to floods, a tank containing a day's supply is usually found sufficient, and this tank may be near the source or at a distance from it and near the town. Examples will be found in the table.

Pumping has also been employed for the supply of two small towns, Loughrea and Strokestown, and it has been proposed in two other cases. In each of the above cases the motive power is provided by turbines, and the water is pumped up to a service tank containing over thirteen days' supply, the level of which commands the highest part of the town.

It is important for sanitary authorities to acquire a clear right to the water they propose to take and to the land on which they may require to erect any works. Where compulsory powers are required for this purpose they can be given by a Provisional Order if the proposed scheme be approved of by the Local Government Board after a local inquiry, but such powers cannot be *exercised* until the Provisional Order is confirmed by an Act of Parliament. Where the Bill for confirming the Order is unopposed the cost of this should be a trifling item in the total cost of the water-works.

Where the land for structural works and a right to the water can be acquired by agreement, a provisional order is not required to obtain way-leave or a right to open the ground along the pipe-track and lay the pipes. The right to lay water-pipes within their district, and subject to certain conditions *without* their district, is given to all sanitary authorities by the Public Health Act, but compensation must be paid for all damage done. Lands that are only required for way-leave are, therefore, not to be included in a provisional order for the purpose of acquiring lands otherwise than by agreement.

In the first table I have given in the different cases the initial rate to meet the loan. This is not to be taken as the actual rate required, for in the first place the charges to meet instalments of the loan and interest may be relieved by water-rates and water-rents as I before mentioned; and secondly, many of the loans referred to were made on the annuity system, requiring a lower rate, but one that would continue the same instead of diminishing with efflux of time of repayment. In some cases the income from water supplied to various concerns by

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agreement very largely contributes to meet these charges; in one case, where the works have been in existence only a few years, they are wholly met in this way, and no rate for the purpose is now struck; and in others, agreements to considerable amounts have been made beforehand, and these facts I commend to the consideration of sanitary authorities contemplating a water-works loan. Persons who are specially interested in having the supply and require more than an average quantity, are much more willing to contract beforehand if they see that the adoption of a scheme somewhat depends on the support they thus offer, and also any sum assured to the sanitary authority in relief of taxation, so far disarms or nullifies opposition.

The improvement of the sewerage arrangements in towns has attracted perhaps more attention than that of the water supply, at least since the Local Government Board was first empowered to sanction loans for sanitary purposes, the applications for sewerage loans have been more numerous than those for loans for water-works. This arises partly from the necessity where it exists for improvements in the drainage of towns coming more readily home to the minds of the ratepayers, and partly because the burden of taxation entailed by such works is usually small compared with the taxation necessary to meet the charges of a water-works loan.

The number of sewerage loans has been swelled by numerous applications during the period of distress in 1880—1, with the object of combining relief through the employment of labourers with utility in the work on which they were to be engaged. The result was that applications flowed in for small loans for sewers in villages and hamlets, which would probably otherwise never have been asked for by their respective Sanitary Authorities. Of course very many of the works executed under such circumstances presented a minimum of utility, indeed it was not easy to stretch the meaning of the word "sewers" to include some of the drains proposed; but every latitude was given, and on the whole I am convinced that a vast amount of good has been effected by works of this kind the execution of which was prompted by the desire to afford relief to distressed labourers, and encouraged by the low rate at which the money was lent by the Government.

As was to be expected there was a general anxiety to have as much of these loans as possible expended in labour and as little as possible on materials and skilled work, hence designs for drains of a primitive character in which almost the whole work could be executed by unskilled labour were often submitted, some of which could not be approved of without modification.

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Many of the proposals at that time were for constructing sewers or a sewer down the centre of the road, passing through small hamlets in which the idea of a house connection with the sewer was not dreamt of, in fact, in such a case the sewer had only to convey away the surface water, and remove and prevent the recurrence of pools that might have formed on the sides of the road, as was very commonly the case, and which if left to stagnate would cause a nuisance. The design of such sewer was not therefore of paramount importance, nor was the method of disposal of its contents, though of course no sanction could be given to a drain of any kind directly discharging into a natural stream.

From such cases in which the loans were only for a few pounds the sewerage loans have ranged up to very large sums for some of the more important towns.

The question of the disposal of the sewage continually presents difficulties in dealing with applications for sewerage loans. There is a wide-spread opinion that the sewage of a district should follow the rain-water to the nearest stream by which it will be carried off, a very convenient system for the district in question but inconvenient to its neighbours down stream. The law is now so explicitly stated by the 19th section of the Public Health Ireland Act that sewerage schemes in which this method of disposal of the sewage is adopted cannot be sanctioned, and are invariably rejected.

In the case of a small village, irrigation of a small portion of land if it can be managed, is perhaps the best plan of disposal of sewage, but there are great difficulties in the way; it is next to impossible for a rural sanitary authority to get any land for this purpose by agreement, and they do not consider the matter of importance enough to take the proceedings necessary for the compulsory acquisition of the land necessary, and besides, the irrigation would require constant supervision and give continual trouble if not attended to.

The disposal of small quantities of sewage on osier-beds, on swampy margins of rivers has been suggested, but this method has not, that I am aware of, been adopted in Ireland. I should like to see it get a fair trial here.

Discharge into tanks, to be emptied by scavengers, if regularly attended to, would also answer well for small towns, but there are difficulties in the way of getting any one to regularly remove or even to receive the contents of such tanks for their manurial value. In only one case that I know of is the sewage of a small town in Ireland taken by farmers, who have constructed carriers for its distribution over their farms, and who have, as I am informed, expressed themselves ready to take any amount

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that can be delivered on to their lands by gravitation. But this is almost a unique case, and the example has not even spread to any town in the neighbourhood.

The larger the town, the greater the difficulty of dealing with this question, though when the authority is an urban one it has greater facilities for carrying out anything requiring supervision. In one case, where the population is about 4,000, it was attempted to deal with the sewage by filtration before discharging it into a mill-race, but after a little time the process was found to be a failure, and the nuisance became so great that an injunction was obtained to compel the sanitary authority, a rural one, to abate the nuisance, and they have obtained loans for a large sum to carry the sewage to a distance from the town to depositing tanks, the effluent liquid being intended to be used to irrigate land prepared for the purpose.

The spongy iron process of filtration is proposed for application to sewage. It appears to possess an element of chemical purification which may be usefully applied to a clear effluent from a depositing tank, but I am not aware that its application to sewage is in practice in this country.

Purification by chemicals has been provided for in full detail at the Ballymena Sewerage Works, and many other works are so designed that this method of dealing with the sewage may be resorted to if found necessary.

I should like to say a few words as to the expression "purification of sewage water, &c." The words "purify" and "purification" are, to a certain extent, misleading when applied to processes connected with water supply or sewage disposal. The word "pure" is defined by Johnson to mean "clean, not dirty, not muddy," and its origin, the Latin "purus," meaning "spotless," applies to a *visible* purity; hence it is often supposed that mechanical filtration, by rendering the effluent, in Johnson's words, "clean, not dirty, not muddy," complies with the requirements of the law and Sanitary Science in *purifying* the liquid. Water containing deadly constituents may be rendered bright and clear by natural or artificial filtration, but it is not thereby rendered *wholesome*, nor is sewage simply "purified" by filtration rendered fit for discharge into a natural stream. I think it would be advantageous if some word were introduced more expressive of what is the object aimed at, such as "sanification," instead of "purification," embodying the idea of a process rendering an unwholesome thing, or state of things, wholesome, without regard to the visible improvement effected. Such a meaning attaches to the words now in use, derived from the Latin "sanus," such as "sanitation" and the very title of this Institute, which words, implying simply a relation

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to health, I may add, are themselves of quite recent introduction, the words in "Johnson," derived from the same source, exclusively refer to curing, or healing, that is, restoring a body to a healthy state. A more suitable word may be found; what is wanted is an expression which will describe the process of rendering an unwholesome thing wholesome, an idea which is not conveyed, except perhaps to a chemical mind, by "purification."

Ventilation, in connection with a sewerage system, is now recognised generally as an essential, and no sewerage loan will be sanctioned unless the ventilation of the sewers is provided for. There is a prejudice in many towns against free ventilation in the streets, and recourse is had to ventilation by means of piping carried up the houses, but in the principal towns the ventilators open directly in the street surface.

With properly shaped sewers, so laid that the sewage finds its way freely and quickly through and out of them no inconvenience whatever results from such ventilating openings being in the streets, if in sufficient number—in fact the more of them the better. I have seen, years ago, sewer-gas pouring back through a sink into a house in one of the best parts of Dublin (indeed, my attention was attracted by the *noise*) owing to the filling of the low levels of the sewer by the tide, but such a thing is, I am sure, not now to be met with; a complete system of ventilation has been introduced, by which pressure on house drains is relieved, and the air in the sewers is purified. For the purpose of constructing ventilators to existing sewers, loans of considerable amount have been sanctioned. The report of the Royal Commission on the Sewerage and Drainage of Dublin, in 1879, and the evidence given before it, contain much of interest on this subject.

With regard to the effect on the rates of the improvements in sewerage arrangements, I find that in only one or two cases has the initial sewerage rate exceeded sixpence in the pound, it varies from twopence to sixpence. In this case there is no relief afforded by incomings such as I have referred to as relieving the charges for a water supply, and the whole charge has to be met by a rate. Loans for sewerage works are repayable by instalments and interest, in not more than thirty years.

Other loans than those I have been referring to have been sanctioned under the Public Health (Ireland) Act, 1878, to a considerable amount. Over £80,000 has been sanctioned for the construction of new streets in this city, which not only are a direct advantage in facilitating traffic, but also aid indirectly, but largely in improving the health of the place by clearing unhealthy areas and opening fresh air spaces. The evidence of

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the Medical Superintendent of Health was very clear and strong as to this at the inquiry as to the issue of a provisional order and loan for the new street at Cork Hill, in this city.

Over £130,000 has been lent for paving and flagging streets and footways, by which their state, from a sanitary point of view, has been greatly ameliorated.

New cemeteries have in many cases been provided by provisional order for the acquisition of the sites for them, and by loans for the construction of the structural works. The advantage of closing old burial places and providing new ones can only be realised by those who have heard the evidence at the inquiries held on applications for closing orders. The powers of the Act have also been most usefully put in force to properly enclose rural burial grounds which by the Act come under the charge of the sanitary authority.

Loans have been made, but only to a small extent, for disinfecting chambers and baths and wash-houses, perhaps the experience derived from the wash-houses now in course of construction in Tara Street, in this city, may lead to their further development. On this subject I may also refer you to the report of the Royal Commission on the drainage of Dublin.

Loans of some magnitude have been sanctioned for town halls, markets, gasworks, &c., which only slightly bear on sanitary matters. Large loans have also been sanctioned by the Local Government Board under the Artisans' and Labourers' Dwellings Acts.

An Act of Parliament was passed last year which, it is to be hoped, will be attended with very beneficial results to a large number of the labouring class. I refer to the Labourers' (Ireland) Act, 1883.

It would be premature for me to say more than that provisional orders confirming schemes made by rural sanitary authorities for the erection of over three thousand houses have been issued by the Local Government Board. The loans which will be required for these will exceed in amount £300,000.

At the next meeting of this Institute in Ireland, I hope it may be reported that results very beneficial, especially from a sanitary point of view, have been attained by the action taken by the rural sanitary authorities in this direction.

Though the works to which I have now briefly alluded as being directly, or indirectly, connected with the operation of the act of 1878 and its predecessors, may not present a large total in the eyes of any one conversant with the long lists of similar works under similar acts contained in the reports of the Local Government Board in England, I think all who know the circumstances surrounding such matters here, and the

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sensitiveness of the ratepayer's pocket to the least increase in the rates, will agree with me that good work has been done, and the successive annual reports of the Local Government Board show that it continues to be done.

I hope that our proceedings at this Congress may attract the attention of those who have the health of sanitary districts in their charge, and who, perhaps, from learning what other sanitary authorities have been and are doing, may be led to look into the state of their own districts; should they find sanitary defects calling for remedies which they were formerly powerless to provide, it is to be hoped, now that they have the power to act, they will use the powers conferred on them, and availing themselves of the facilities afforded, acquit themselves of the responsibility they are under to the people in their charge and to the community at large.

Sir Robert Rawlinson, C.B. (President of the Congress), said he could only express his unbounded admiration for the able address which had just been read by one whom he would venture to call his colleague, for he was proud to be associated as Engineering Inspector for England with Mr. Cotton, the Engineering Inspector for Ireland. The address was worthy of consideration in many respects. With regard to the subject of loans, he held that Parliament and the Government had made a very grievous mistake in altering the rates of interest for loans for long periods, bringing it up to 4¼ and 4½ per cent. thus putting direct taxation upon improvements. One of the first principles of a Government should be to assist the people at the cheapest possible rate without subjecting the Exchequer to any loss; and he had no hesitation in saying that every loan might safely be granted at 3½ or possibly 3¼ per cent. which would give a great impetus to the carrying out of works and be a great relief to the local ratepayers. When he was sent into Lancashire during the cotton famine to advise the Government as to the mode of giving relief, it was a great experiment, yet not a new one, because they had had a previous experiment in Ireland on a great scale, which had not turned out so satisfactorily as it might have done. When he went into Lancashire the ministry of the day made up their minds that it was necessary to provide money to relieve the distress, but they did it with the certainty that almost half that money, as had been the case in Ireland, would be wasted. It was, perhaps, right to state that at the outset he said to the Right Honourable Mr. Villiers, M.P., who was the Cabinet Member under whom he was working, "If these works are carried out under our direction, I undertake to pledge myself that if the Cabinet will let us have our way there shall not be one farthing of loss." It was very satisfactory that nearly two millions were expended upon works of sanitary improvement. Over four hundred miles of good roads were made, sewers were constructed, and everyone admitted that in a sanitary sense Lancashire was put forward

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twenty-five years ahead of the rest of the country by the advancement of that money. The term had now nearly run out for the repayment of the whole of the loan, and up to that date not one sixpence of the debt had been repudiated, but every farthing due had been honestly repaid. In distributing State money on previous occasions large sums had been spent on administration and supervision. In the case of Lancashire the supervision of the expenditure centred in himself, and the total cost to the State for administering the 1¾ millions of money did not amount to 3/6 per cent. Loans of this sort should be administered at the lowest possible cost to give the greatest possible benefit; and the State, instead of attempting to make a gain by charging a high rate of interest, would do wisely to lend the money under proper guarantees, even at a trifling loss to itself, though there was no necessity for that.

URBAN SANITARY DISTRICTS.

	Population as by Census, 1881.	Valuation.		Population as by Census, 1881.	Valuation.
		£			£
Armagh	10,070	16,925	Kilkenny	12,299	17,288
Athlone	6,755	9,517	Killarney	6,651	7,698
Ballinasloe	5,052	8,743	Kilmainham	5,391	7,241
Ballymena	8,883	21,414	Kingstown	18,586	78,000
Banbridge	5,609	12,646	Kinsale	5,386	5,760
Bangor	3,066	10,916	Letterkenny	2,188	3,401
Belfast	208,122	549,560	Limerick	38,562	66,343
Blackrock	8,902	49,139	Lisburn	10,755	18,383
Bray	6,535	25,570	Listowel	2,965	—
Carlow	7,185	11,125	Londonderry	29,162	69,032
Carrick-on-Suir	6,583	8,914	Lurgan	10,135	18,408
Cashel	3,961	3,690	Monaghan	3,369	5,913
Clonakilty	3,676	4,856	Navan	3,873	5,890
Clonliff, Drumcondra, & Glasnevin	4,865	17,978	New Ross	6,670	8,038
			Newry	14,808	32,760
			Newtownards	8,676	10,347
Clonmel	9,325	15,336	Parsonstown	4,955	8,731
Clontarf	4,210	17,520	Pembroke	23,222	91,684
Coleraine	5,899	12,805	Portadown	7,850	17,458
Cork	80,124	152,070	Queenstown	9,755	20,867
Dalkey	3,234	13,196	Rathmines and Rathgar	24,370	113,118
Drogheda	12,297	19,104			
Dromore	2,491	4,503	Sligo	10,808	19,019
Dublin	249,602	651,443	Templemore	2,800	3,926
Dundalk	11,918	21,477	Thurles	4,850	6,110
Dungarvan	6,306	8,269	Tralee	9,910	12,044
Ennis	6,307	6,907	Trim	1,586	2,154
Enniscorthy	5,666	6,944	Warrenpoint	1,887	7,388
Enniskillen	5,712	11,331	Waterford	22,457	38,161
Fermoy	6,454	9,875	Wexford	12,163	15,784
Galway	15,471	26,135	Wicklow	3,391	6,270
Hollywood	3,293	11,571	Youghal	5,396	9,571
Kells	2,822	3,530			

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PARTICULARS OF SOME LOANS FOR WATERWORKS.

PLACE.	Population, 1881.	Valuation.	Loan.	Proportion of: Loan to population	Proportion of: Loan to valuation.	Proportion of: Valuation to population.	Initial rate (possible maximum)	
Urban Districts.		£	£	£	£			
Bangor	3,066	10,916	9,878	3·22	0·90	3·58	14·40	In progress
Warrenpoint	1,887	7,388	6,000	3·18	0·81	3·91	12·15	
Hollywood	3,293	11,571	10,000	3·04	0·87	1·51	13·05	
Sligo	10,808	19,019	28,000	2·60	1·47	1·76	22·05	In progress
Ballymena	8,883	21,414	23,000	2·59	1·07	2·41	16·05	In progress
Wexford	12,163	15,784	30,000	2·47	1·90	1·30	28·50	
Dundalk	11,974	21,477	26,000	2·17	1·21	1·80	18·15	About to be commenced.
Fermoy	6,454	9,875	13,000	2·01	1·32	1·53	19·60	In progress
Wicklow	3,391	6,270	6,000	1·77	0·95	1·85	14·25	
Ennis	6,300	6,907	11,000	1·75	1·59	1·10	23·85	
Tralee	9,396	12,044	15,666	1·67	1·30	1·28	19·50	
Coleraine	6,694	12,805	9,300	1·39	0·73	1·91	10·95	
Enniskillen	5,712	11,331	7,700	1·35	0·69	2·00	10·35	
Killarney	6,651	7,698	8,000	1·20	1·04	1·16	15·60	In progress
Rural Districts.								
Greystones	355	2,125	2,500	7·04	1·18	5·99	17·70	
Rostrevor	600	3,602	3,900	6·50	1·08	6·00	16·20	
Portrush	1,196	5,949	6,500	5·44	1·11	4·97	16·65	
Lisdoonvarna	398	2,236	1,950	5·00	0·87	5·62	13·05	
Kilfenora	307	3,669	1,266	4·01	0·37	11·95	5·55	
Enniskerry	400	998	1,400	3·50	1·40	2·50	21·00	
Dungannon	4,081	10,456	13,500	3·31	1·29	2·51	19·35	
Omagh	4,126	9,000	12,115	2·94	1·30	2·18	19·50	
Kildorrery	400	15,896	1,050	2·63	0·06	39·70	0·80	
Buncrana	764	2,382	2,000	2·62	0·84	3·11	12·60	About to be commenced.
Strabane	4,196	13,070	9,400	2·24	0·72	3·12	10·80	
Limavady	2,954	5,364	6,000	2·03	1·12	1·81	16·80	
Ballymoney	3,049	7,000	6,000	1·97	0·86	2·30	12·90	In progress
Ramelton	1,600	2,768	2,820	1·76	1·02	1·75	15·30	
Moville	1,129	1,970	1,846	1·64	0·90	1·75	13·50	
Strokestown	700	2,439	1,100	1·57	0·45	3·50	6·75	
Keady	1,598	4,690	2,500	1·56	0·53	2·94	7·95	
Mallow	4,439	11,250	6,250	1·48	0·55	2·53	8·25	
Larne	3,995	9,556	5,000	1·25	0·52	2·39	7·80	In progress
Miltown Malbay	1,400	3,450	1,650	1·17	0·48	2·46	7·20	
Loughrea	3,159	¾ on 4506 ¼ on 2959	3,770	1·16	...	...	9·41 4·80	
Lisbellaw	335	623	300	0·89	0·48	1·86	7·20	Rate paid by landlord, J. G. V. Porter, Esq.
Irvinestown	800	1,487	650	0·81	0·44	1·86	6·60	
Kilfinane	1,299	5,143	800	0·62	0·15	3·95	2·25	
Bushmills	1,008	1,901	600	0·60	0·32	1·89	4·80	
Ennistymon	1,331	4,385	650	0·48	0·15	3·30	2·25	
Ligoniel	3,497	3,838	1,650	0·47	0·43	1·10	6·15	
Galbally	200	333	300	1·50	0·90	1·67	13·50	
Little Island	500	2,990	1,250	2·50	0·42	5·98	6·30	
Belmullet	900	⅔ on 1773 ⅓ on 9153	1,422	1·58	...	...	9·72 0·47	

The rates in the last column show the maximum possible rate if the Loan were for 50 years repayable by instalments. The actual initial rate may be less, owing to income from other sources.

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WATERWORKS.

DIFFERENT TYPES OF CONSTRUCTION.

1.—*Artificial Storage Reservoirs.*

Ballymena.....	Population,	8,883	Capacity of Reservoir,	—	Million Gallons.
Bangor	"	3,066	"	20	"
Dundalk	"	11,913	"	32	"
Ennis	"	6,300	"	25	"
Hollywood ...	"	3,293	"	11	"
Moville	"	1,129	"	2	"
Fermoy	"	6,454	"	27	"
Omagh	"	4,126	"	25	"
Portrush	"	1,196	"	9	"
Dungannon ...	"	4,081	"	15	"
Ramelton	"	1,600	"	7	"
Wicklow	"	3,391	"	17	"
Mallow	"	4,439	"	3	"
Sligo	"	10,808	"	50	"
Buncrana	"	764	"	—	—

2.—*Lakes made to act as Storage Reservoirs.*

Armagh	Population,	8,797	.....	Lowry's Lough.
Newry	"	15,084	.....	Cam Lough.
Ballina	"	5,760	.....	Lough Broghly.

3.—*Service Tanks only.*

Tralee.....	Population,	9,910	Capacity of Tank,	855,000	Gals.	Supplied from a Stream.
Killarney	"	6,651	"	150,000	"	"
Belmullet	"	900	"	59,000	"	"
Greystones ...	"	700	"	476,000	"	"
Enniskerry ...	"	400	"	100,000	"	"
Coleraine	"	6,694	"	600,000	"	Supplied from Springs.
Larne.....	"	3,995	"	370,000	"	"
Limavady	"	2,954	"	135,000	"	"
Lisbellaw	"	335	"	169,000	"	"
Bushmills	"	1,008	"	10,000	"	"
Galbally	"	200	"	2,800	"	"
Kilfenora	"	307	"	37,500	"	"
Irvinestown ...	"	800	"	32,000	"	"
Little Island...	"	500	"	3,200	"	"
Ballymoney ...	"	3,049	"	Drumbest Lake		Full of Springs.

4.—*Pumping by Turbines.*

Loughrea	Population,	3,159	Capacity of Tank,	118,000	Gallons.
Strokestown...	"	700	"	400,000	"

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On "Sewage Disposal," by Professor HENRY ROBINSON, M.INST.C.E., F.G.S., F.R.MET.SOC.

THE outcome of several public enquiries which have taken place during the last year or two, and of much valuable data derivable from other sources, establish, we think, a well-marked advance with reference to sewage disposal; and it may be of use, as well as of interest, if we lay before this Congress the conclusions which, we conceive, are deducible therefrom. We propose to deal with the subject under the following heads: 1. Sewage disposal on land. 2. Sewage disposal by chemical treatment. 3. Sewage disposal by discharge into a tidal river, or into the sea, without treatment.

1.—SEWAGE DISPOSAL ON LAND.

The object of dealing with sewage on land may be taken as twofold, namely, to purify it (which is the sanitary object), and to utilize its manurial products (which is the agricultural object). Where want of skill, or where prejudice has existed, these two have not been properly separated, and the results have been in many cases unfavourable to sewage disposal on land from either of the beforementioned points of view.

It has been regarded as an axiom that clay land cannot be employed to clarify sewage. This is true when it is proposed to pour the sewage on it as if the land were porous. Very recent experience, however, has led to clay land being converted from an impervious to a pervious condition, by which it has been successfully utilized. This is effected by digging out the clay to a depth of about 6 feet, burning it into ballast and replacing it in layers, interposed with an occasional layer of open alluvial soil, the whole area being well drained with a free outlet for the effluent. We have successfully carried this plan out, and with the result, that whereas it was not possible previously to clarify the sewage of 100 people to an acre of clay land, the prepared filtration area has been able to continuously clarify the sewage of about 1,500 people to the acre. The cost of converting clay land into this form of filter may be taken as varying from £750 per acre to £1,000 per acre according to local circumstances. One area which we have just completed has cost £1,000 per acre. Before sewage is passed on to these filters (or on to land) it should be strained so as to remove the larger particles. The best arrangement for this purpose is to pass the sewage

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upwards through a straining medium (not downwards), and to run the solids from the bottom of the straining tank on to a low-lying piece of land for digging in as they are run out.

Where such a filtration area is made to form part of a sewage farm it acts as a safety-valve, and enables the land and crops to have a rest when they do not require further irrigation; at the same time the process of purification is not interrupted.

If open porous land is available for sewage purification, and if it can be drained 6 feet deep to a good free subsoil, so that the effluent can get readily away, we find that the sewage of from 600 or 700 people can be dealt with on each acre per annum with both good agricultural and sanitary results.

In our Address as President of the Engineering and Architectural Section of the Congress of this Institute at Newcastle-upon-Tyne, in 1882, we directed attention to the important investigation which had been conducted by Mr. R. Warrington, of Rothamsted, the result of which was to show the action which goes on in the soil when sewage is passed through it. Further information, which the same observer has published since that date, is of equal value, and deserves to be read by all who have to advise in regard to sewage disposal on land. The process of "Nitrification" (as it is termed), which he has so fully investigated, consists in the conversion into nitrates (which serve to nourish plant life) of the organic matter in sewage. This takes place by the action of a living ferment of the bacteria family, which is created by and feeds on the impurities in sewage, and these organisms both consume the impurities and convert them into nitrates.

The action of living agents thus brings about the oxidation of the organic matter in sewage, just as worms, larvæ, fungi, and insects, feed on the vegetable matter in the soil, increasing the amount of nitrogenous material in it.

Experience during the past year or two has proved the feasibility of preserving green crops in a succulent state by compressing them in Silos, so that they can be utilized for cattle fodder in the winter. This system deserves notice in connection with Sewage Farming, as we are of opinion that it will prove a valuable means of getting over the well-known practical difficulty which is experienced of finding a market for the large amount of green crop which is produced by sewage irrigation. In speaking of this system the term "Silo" is applied to the artificial chamber or receptacle for green crops (such as grass, vetches, clover, &c.). The term "Silage" is applied to the crop thus treated, and the term "Ensilage" is applied to the process of making "Silage." The details of the construction of Silos cannot be referred to here beyond stating

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that what is required is to construct a pit or chamber either in the form of an excavation in the ground, with a brick or other lining, or by building it above the ground. The object is to enable the green crop to be deposited in an air and water-tight chamber, in which pressure can be applied to the crop to compress it. This is effected in some cases by well treading the crop after it is laid in the Silo, and then spreading layers of earth to about a couple of feet and pressing the covering well down. Another way is to construct the Silo with a movable covering of the exact size and shape of its interior. This cover is raised and lowered by suitable chains and rollers. After the crop is placed in the Silo the cover is lowered and weighted, so that a thorough compressing is effected; the weight applied giving about 200 lbs. or so per square foot of surface. Salt is sometimes added as the crop is placed in the Silo. A crop thus dealt with is stored for months; when the Silo is opened the fodder is found preserved, and in a state readily taken to by cattle. It is desirable to choose the site for the Silos so that the fodder is preserved somewhere near the place of consumption; also to lay out the works so that as little handling as possible is required. For instance, the Silo should be on sidelong ground, so that the crop can be carted and tipped at a high level, and the silage taken out for use at a lower level.

2.—Sewage Disposal by Chemical Treatment.

In the last edition of our book on "Sewage Disposal," in speaking of precipitation, we said "the purification of sewage by Chemicals has been the subject of misapprehension, owing to the extravagant advantages which have been claimed for the system by its advocates." This is even more true now than it was two years ago, inasmuch as in the recent scheme for dealing with the sewage of the Thames Valley chemical treatment *per se* was relied on to produce from the sewage of a future population of 350,000 an effluent at all times fit to be discharged at one point into the river Thames above London, but the Parliamentary Committee rejected it. One part of the report of this Committee deserves attention, when speaking of sewage treatment by chemicals. It is as follows:—"Your committee believe that in these cases the process of filtering the chemically purified effluent through earth ought, if possible, to be adopted, which was not provided for in the scheme under their consideration." This opinion is exactly in accordance with our experience, and is that which we have held throughout. It is at the root of the whole matter, because efforts are made by those interested in chemical processes to attain as high a standard of purity as possible with the attendant heavy expense

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of chemicals. Experience shows that it is impossible at all times and seasons to be sure of a constant and uniformly high standard of purity, and that chemical works should be supplemented by a filtration area, however small. The addition of this, however, enables a lower standard of effluent from the precipitation tanks to be admissible, and this can be attained with very simple and inexpensive chemicals.

In the course of our practice we have had to advise as to the majority of the processes, and to design the works for their being carried into operation. We have found that the cost of such works complete varies from ·091 to ·166 of a £ per head of the population, and that the average cost of the works at several towns which we have been connected with is ·123 of a £ per head. This figure may be conveniently followed by that of the cost of treatment, which we find varies from ·036 to ·110 of a £ per head per annum, and an average of several places gives ·06 of a £ per head per annum. The above figures apply only to places where the very highest standard was sought to be attained, but our more recent experience leads us to modify the arrangement of the works and the cost of treatment, so as to rely on filtration of the effluent as an important factor. We estimate that under these conditions the cost of the works complete would be about ·075 of a £ per head, and the cost of treatment ·04 of a £ per head per annum.

The disposal of the sludge has always been a difficulty in these works, but this is now overcome in two ways: either by digging it into the ground, as is done at Birmingham now, or by pressing it into cakes in filter presses. It is found at Birmingham that one ton of sludge with 90 per cent. of moisture is produced from 1,000 people. There the lime process is used. We have found that about one ton to 2,000 people is produced where a salt of alumia or iron is used with the lime. At Birmingham the sludge is dug into the land adjoining the works, and it is found that one square yard of land will take one ton of sludge with 90 per cent. of moisture once in three years, which results in three yards of land being required to be provided for each ton of sludge. This system of digging in sludge is successfully carried out as regards freedom from nuisance. Where land is not available to dig in the sludge it is necessary to make it portable for removal and disposal away from where it is produced. This is best effected by filter presses. Appliances are made for this purpose, by which the sludge is pressed to a consistency of about 50 per cent. of moisture. The cost of effecting this is about ·007 of a £ per head per annum. It is found in practice that where the sludge is produced by straining the solids from sewage before

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passing it on to land for purification, it requires a little lime to enable the press to work well. About two barrow loads of lime for each ton of pressed sludge suffices.

It has been thought that the cost of precipitation would be covered, and even a profit gained, by the sale of the sludge. This hope, however, is not nearer realization now than it was in the time, now gone past, when chemical processes were relied on to turn sewage from a profitless into a profitable commodity. There is, consequently, less justification now than there was at that time for adopting a precipitation system for sewage disposal. It is entirely a question of carefully considering the engineering and financial points involved, regardless of the sanguine representations of interested or enthusiastic advocates of any particular system.

As the estimated manurial value of the sludge which is precipitated from sewage by the addition of chemicals does not seem to be capable of realisation, we think that probably the reason may be found in the fact that the chemicals arrest that process of decomposition which is essential to the conversion of the organic matters into nitrates for vegetation to utilize. This explanation will be understood in the light of what we have already described in regard to "nitrification." If this view is correct it would follow that the more completely and permanently the sludge is deodorized by the chemicals the less capable is it of passing through the necessary stages of decomposition by which its manurial value can be realised.

As mistakes are constantly being made in regard to the weights of sludge with varying degrees of moisture, the following table may be useful :—

100 tons of sludge with 90 per cent. of moisture=				50	tons with	80	per cent.
100	"	"	"	33·3	"	70	"
100	"	"	"	25	"	60	"
100	"	"	"	20	"	50	"
100	"	"	"	16·6	"	40	"
100	"	"	"	14·3	"	30	"
100	"	"	"	12·5	"	20	"
100	"	"	"	11·76	"	15	"

3.—Sewage Disposal by Discharge into River or Sea.

We will next deal with the conditions which should be fulfilled where it is sought to utilize a river or the sea into which to cast the sewage of a town. If it can be ascertained beyond question that at the proposed point of discharge the currents at all times will carry the sewage right away, and will not at the same time produce mischief at a distance (which is often

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omitted from the consideration), then that arrangement may be accepted as a good one. This, however, seldom occurs.

A river has been looked upon by manufacturers and local authorities as the natural carrier of the refuse from their district. This view has been persevered in in spite of the Rivers Pollution Prevention Act of 1876, which is practically a dead letter. The public, however, who use a river either for pleasure purposes or for obtaining their water supply, have of late years grown more and more united in their efforts to stop this abuse; and there is no doubt that these efforts will eventually succeed. In a paper which we read last year at the Congress at Glasgow we pointed out the steps that were necessary to be taken to render this Act operative, and we refer our hearers to that paper if they wish to follow the matter further.

The effect of discharging sewage matter into a river has been the subject of much controversy amongst chemists. Some allege most positively that the injurious properties in the sewage are indestructible. This has led to alarmists demanding that under no circumstances ought sewage to pass untreated into a river. We have given considerable attention to this vexed question, as it requires to be grasped by any engineer who has to advise on the selection of sewer outfalls, and it appears to us that the balance of evidence is against the alarmists. Every river has a certain power of oxidizing impurities in proportion to the extent of oxidization of the river itself. Besides this, there are the powerful purifying influences exercised by the plants and animalculæ which exist in rivers.

It has been ascertained that entomostraca consume dead animal matter, and where this is wanting they do not live, but where it is in abundance they thrive. It follows, then, that these minute animals exercise an important function in absorbing sewage impurities. They multiply prodigiously in these impurities, and are both created by them and fed upon them, converting foul and dangerous matters into harmless ones, in a similar way to that which we have referred to as nitrification when speaking of the action of bacteria in the soil. Considering that these organisms arise from and are fed on concentrated filth, it is obvious that they cannot live when the conditions favourable to their existence disappear. This would be the case when the sewage is discharged into a large volume of water with a different temperature to that which suits them, and with powerful oxidizing influences at work. These conditions, added to the difficulty they must experience to find their natural food—namely, concentrated sewage—where the sewage matter becomes so greatly diluted, accounts for the fact that in a short run of a good river, sewage impurities

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largely disappear. The action of weeds and plants also aids purification to a very large extent. Minute plants, such as confervoid algæ and the like, also assist in oxygenating the river, as when exposed to light they decompose carbonic acid, and liberate oxygen.

The practical question which has to be answered in every case where sewage is proposed to be discharged into a river requires to be approached from two points. The first is whether a nuisance will be caused at the spot to which objection would be taken. If this is likely to be the case then the fact that the sewage will get purified in a short run of the river does not meet the objection. The second point requires a careful consideration of the condition of the river, both from an engineering as well as from a chemical and biological point of view. Decisions on these matters have too often been arrived at in a rough and ready way. They require skilful treatment, as the interests—both commercial and hygienic—which are affected are too great to permit of them being dealt with by any who are not well-informed and careful.

The general conclusions which we deduce from our observations are as follows:

1. That chemical precipitation is not so necessary now, as it was considered to be a few years ago, in cases where land for irrigation is not procurable.

2. That the efforts to profitably remove the manurial elements from sewage by chemicals not having been successful, the system should be adopted *per se* only where a filtration area cannot be obtained.

3. That the success which has attended the construction of filtration areas where the land is clayey, and the successful results which have been obtained from a combined straining of sewage and of subsequent filtration through small areas of artificial filters, point to the adoption of one or other of these systems in many cases where chemical treatment would previously have been advised.

4. That the injurious effects of passing untreated sewage into a river depend upon not merely the relative volumes of the sewage and the river, but chiefly upon the power of the river to oxidize the sewage, which power is in proportion to the extent of oxidation of the river itself.

[*For discussion on this Paper see page* 239.]

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On "The Collection and Disposal of House Refuse," by W. EASSIE, C.E., F.L.S., F.G.S.

It is most interesting, as well as instructive, to read in the pages of medical and sanitary journals how the dry refuse from houses is dealt with in various home, continental, and transatlantic towns and cities. But it would be a work of supererogation to lay before you even a digest of this, and in the few remarks which I have to make I will confine myself, as far as I can, to the method of dealing with the dust from houses in our home towns and cities, giving express notice to the methods which rule the disposal of dust in the London Metropolitan district. This information has cost me much time and considerable expense to collect.

I have not been able to find any statistics giving anything like the exact analysis of the various materials which go to make up ordinary house refuse, such as is thrown into the dust-bin, but whilst Paris was scavengered in the ordinary way by rag-pickers or *chiffoniers*, and before the present municipal cart system was introduced, that city possessed about 500 rag merchants, who employed each some half-dozen rag pickers, whose duty it was to collect and sort the house refuse thrown outside the houses. Out of every 136 lb. of refuse thus collected in Paris the following gives the analysis of what can be sold: Paper, 40 lb.; rags, old linen, and wool, 18 lb.; bones, 28 lb.; glass, 8 lb.; waste cloth, dressmakers' scraps, thread, &c., 19 lb.; iron, brass, and lead, meat tins, and capsules from bottles, 13 lb.; old shoes, leather, &c., 6 lb.; corks, indiarubber, and broken toys, 4 lb.

The above will not give any fair estimate of London refuse, because it represents only the weight of the assorted articles taken from out of the dust, and does not include household ashes, the excrement of which, in our country, where coal is so abundantly used, would, it must be remembered, largely increase the amount. In most towns there would be a much heavier item for broken earthenware, for old blacking-pots, ink bottles, and the like. In the analysis of the Parisian refuse, I only mentioned articles which were of value to the rag-picker, and there must of course be a great deal of earthenware thrown away there, but taking into consideration the inhabitants of the two cities, Paris and London, there could be no question that in the item of glass and earthenware the quantity yielded in London would preponderate. One thing I dare be certain about,

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and it is that London would beat the whole of continental Europe in a show of empty ink bottles and medicine bottles. Some time ago, my friend, Dr. Roth, of Dresden, the eminent state sanitarian, put himself under my care, to show him among other things how we managed the disposal of our house and street refuse. I took him to Paddington, which is the most complete establishment I know of, and we were amused upon seeing the number of full medicine bottles which had never been emptied, as compared with the empty bottles which had been thrown into the dust-bin.

The most complete treatise dealing with the collection and removal of refuse from houses, as enjoined upon every local authority by the Public Health Act, 1875, is that of Mr. Percy Boulnois, C.E., which will be found under the head of Scavenging, in his work published in 1883, entitled "The Municipal and Sanitary Engineers' Handbook." He enters fully into the law of dust removal, but I have not time to allude to this, and desire rather to make a few remarks concerning the practice of dust removal as it is carried on at present.

House dust in London and its suburbs is either collected by scavenging carts, the bells attached to which in some towns inform the householder that the dustman is passing, and that his portable receptacle of dust and other refuse, which he has previously placed in a handy spot, will be carted away on pointing it out. Or if dust-bins are the rule, the letter D placed in the window will indicate to him that the bin is full and must be emptied. It is not often that the dustman calls without invitation, and more often he requires the solace of a small honorarium, especially if there is any garden refuse, wall plaster, old paper-hangings, green-house clinkers, or extraneous matter of that kind, which according to most authorities the local board are not expected to remove. Only ashes, peelings, kitchen vegetable leaves, and inside house refuse is bargained for.

All sanitarians, medical or engineering, are of opinion that something better than our present system of dust-bin storage might be devised. Not that the dust-bin is outrageously evil in its conception, but rather that it is abominably treated. It should not contain vegetable and animal matter commingled, rendering the neighbourhood, during the upheaving and emptying of the fermenting matter noisome with dangerous gases, and not only this, but causing the dust-cart to give off these foul gases during its progress through the streets.

Undoubtedly, the dust-bin could be made portable, the contents kept automatically disinfected every time the lid was raised, but the chief amelioration would result from a constant

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burning of the vegetable refuse in the kitchen fire. This, however, would require almost to be made incumbent upon the householder by some bye law, which is hardly likely to be enacted. One word more about these fixed dust-bins and I have done with them. They are seldom water-tight, mostly placed against the wall of the house, and allow the liquids to drain under the floors and cause a rising dampness in the wall or the porous walls permit of the foul air being sucked through the walls into the warm rooms.

In London they are mostly constructed underneath the area steps, and their exhalations are breathed by servants, tradesmen, and passers by; but frequently it will be found that one of the area vaults has been appropriated, and it needs no argument to show how such large receptacles must affect the sweetness of the basement. I have more than fifty times also found the dust-bin inside a vault which is enclosed in the house, and thus virtually poisoning its atmosphere. Very often, too, just above the dust-bin will be found a cistern, with a badly fitting cover, and supplying some of the sinks in the basement.

The contents of all dust-bins, at least in London, resolve themselves in four products:—1st, the "ash," or that compound of fine ash, boot brushings, house dust, &c., which is for the most part moulded into bricks; 2nd, the ashes or cinders and fine coal which will not pass through the sieve with the foregoing, and which is called "breeze" and used as fuel wherewith to bake the bricks; 3rd, "hard core," such as broken pottery and other hard refuse which is not worth selling, and is chiefly used for road making; and lastly, "soft core," which means all kinds of animal and vegetable refuse, of course the most difficult material to deal with, necessitating, as in the case of Lambeth heaps, sprinkling with carbolic acid powder before it is barged away for agricultural purposes.

By far the greater number of the Metropolitan vestries, viz.:

The Strand,	Poplar,
Westminster,	Hampstead,
St. Giles,	St. Pancras,
Holborn,	St. Saviour's, Southwark.
Rotherhithe,	Lambeth,
Shoreditch,	Camberwell,
Hackney,	Wandsworth,
Bethnal Green,	St. Marylebone,
Whitechapel,	Chelsea,
St. George in the East,	Limehouse,

contract with different parties to call round at every street in the district from twice a week to once a fortnight, and in

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most cases, they pay the contractor to cart the dust away. The contractor has in the majority of cases, a wharf on the river or canal, as the case may be, where he either sifts and sorts the refuse and disposes of it piecemeal—the "ash" and "breeze" to brickmakers, the "hard core" to contractors for road foundations, and the "soft core" to market gardeners and farmers for manure, or he shoots the refuse direct into barges, without sifting, and disposes of it as it is to brickmakers. If he finds no ready market for the dust, &c., he either lets it accumulate or takes it down the Thames, presumably beyond Lee Reach, and shoots it into the water.

In the case of some of the outlying districts, such as Hampstead, the contractors simply cart the refuse and dust in bulk to brickfields in the neighbourhood. Many of the vestries contracting as above are thinking of adopting better methods of disposal and working the system themselves, thus saving expense. The Poplar Vestry has just instituted pails in place of dust-bins, and is negotiating for a piece of land, where they propose to erect a furnace and to try burning the greater part of the refuse.

The system adopted by St. Olave's, Hammersmith, St. George the Martyr, and Bermondsey is somewhat similar to the above; they each have a wharf in their respective districts, where they shoot the dust, sift and sort it, and then contract with a man to take it away.

Islington, Plumstead, Mile End, Woolwich, Lewisham, Clerkenwell, Greenwich, Kensington, St. Mary's (Newington), Paddington, St. Luke's (City Road), and the City Commissioners dispose of all refuse themselves. Of these Clerkenwell, St. Luke's (Paddington), and Plumstead have wharves where they sort, and whence they barge away to sell for brick-making, road-making, and manure.

Islington, Mile End, and St. Mary's (Newington) have each a depôt, where they screen into trucks and send off to the country by rail.

Lewisham, Greenwich, and Kensington shoot at various places, without sorting; in fact, at any place in their districts where they can find a market, the places being mostly brickfields.

Woolwich shoots at Charlton, where there is a place wants filling up.

The City Commissioners burn their refuse. Of the above special mention should be made of St. Mary's (Newington), Paddington, and the City Commissioners.

St. Mary's (Newington) has a large depôt in their district of Walworth, on the London, Chatham and Dover Railway, and

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one in the country at Longfield. Their carts call round at each street once a week and take all dust, refuse and slops to their depôt in Walworth. Here the dust and refuse are sifted and sorted in the way common among the contractors by women. The ashes and breeze are sold to brickmakers, the hard core for road foundations, and the soft core and slops (after being treated as explained hereafter) for manure.

The manure or "mixture," as they term it, is made in the following way:—A large bed is made about eight inches deep, of old straw, bought by the vestry from the various stables in the district. On this foundation the soft core, consisting of paper, rags, peel, &c., is spread, then another layer of old straw, which is heaped up at the edges so as to form a basin or tank about four feet deep. In this basin the slops obtained in wet weather are emptied, and dry dust is sprinkled on the top of all. The bed thus formed is then allowed to stand for a week or so, at the end of which time all the superfluous water has drained away through the straw, and the "soft core" has fermented and rotted and become thoroughly decomposed. The bed is then mixed up and sent away in trucks to the country, where there is a very ready sale for it among the farmers for manure. As many as thirty trucks a day are sent away from here sometimes. The Commissioners have six of these beds, which they work alternately, and there is very little perceptible odour arising from them.

The country depôt at Longfield is used for storing the ashes, &c., when there is not a ready market for them. The system appears to work very well.

The Paddington system is chiefly remarkable for the method of sifting and sorting by machinery, thus to a great extent obviating the necessity of employing the manual labour of women. The dust, &c., brought in by the carts is shot into a large screen, which separates the larger materials such as flower pots, bottles, and culinary utensils. The smaller material is carried up by buckets fixed on an endless chain, and is emptied into two sieves placed at an angle to each other like the roof of a shed.

The paper, bones, &c., collecting on these is raked off by women and sorted, and the dust and ashes falling through is brought up by another system of buckets on an endless chain, and conveyed along a wooden trough into the barge, where it is taken away and sold to brickmakers. The soft core sorted out is sold as manure or burned, and the hard core is used for road foundations as usual, the flower pots, &c., being taken out, of course, and sold separately.

The slops are emptied into a large tank built of wooden planks, the planks being placed some two or three inches

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apart, and the crevices thus formed filled with straw. Through this straw the water drains, and runs away into the sewers. The resulting dry mud is barged away and makes a good mould.

The yard is kept in very good order and is quite extensive, all the vestry carts being made here, and the horses being stabled and shod here.

The City Commissioners of Sewers burn their refuse, and the system is said to give every expected satisfaction. The other vestries who make use of a furnace for burning some of their soft core—the Newington and St. Olave's—are of opinion that the refuse burns very slowly and is very troublesome.

The system of destruction of all kinds of house refuse by burning it in suitable furnaces was reported upon by Dr. W. Sedgwick Saunders in 1851, and it may be taken as forming the most complete essay upon the subject. In this process, which has been largely adopted in Leeds, Bradford, Warrington, and Manchester, &c., &c., and in Continental cities, an apparatus which is termed a "destructor" destroys by fire everything combustible in house and trade refuse; and the second apparatus, which is called the "carboniser" deals with the vegetable matter and converts it into charcoal. At Leeds, large masses of refuse, house dust, market and paved street sweepings, midden night soil, are delivered on the top of the "destructor," and as the material perishes from below it sinks down the surface holes, and at the front, pots, pans, glass, crockery, clinkers, and all coarser materials are extracted. The large quantities of iron utensils fall to the front and are raked out and allowed to cool, and afterwards sold. When the clinkers, molten metal, and glass, all of which are fused together, has been drawn from the "destructor," the clinkers which result from the process of burning the refuse are in some places ground into powder, and when mixed with lime and water it forms a cement which is much sought after; hard bricks are also made from the same material.

I have nowhere in this paper referred to or intended any reference to the treatment of condemned meat and the best method of dealing with that, but have confined myself simply to the disposal of the dust from ordinary dust-bins. I may mention, however, incidentally, that there can be no doubt that "the carcass-crusher, or devil" at work near Warrington, &c., which breaks up the body which is afterwards treated by the rotary fat rendering machine of Mr. Firman, is the completest and most satisfactory method of dealing with that.

Mr. Healey, of Brig House, near York, has lately brought out an improved furnace for converting town and other refuse

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into clinkers, which appears to be very simple. It would have the apparent advantage over some other methods, that very bulky articles could be destroyed in it, such as bedding, mattresses, and the like.

Anyone who thinks that a system of taking the refuse of towns or cities by barges out to the sea and emptying it there, must have a very poor notion of how much more satisfactorily and economically this material can be disposed of by separation, appropriation, or destruction. At New York, and I believe in Liverpool, a great deal of refuse has been got rid of by sea immersion, but it would appear that it was simply for want of space and convenience to utilise it that this crude system of disposal was resorted to.

After a due consideration of the foregoing statements, I think it will be taken for granted that the burning of the refuse is the most satisfactory system extant. There seems to be a very general feeling in favour of this mode of disposal, provided it can be effected easily, and numbers of the vestries are watching with interest the results obtained by the City Commissioners and the system adopted by St. Mary's (Newington).

[*For discussion on this Paper see page* 239.]

On "Public Cleansing," by JAMES YOUNG, Superintendent of Cleansing, Dublin.

The cleansing of towns cannot be termed a pleasing topic, but its consideration is none the less necessary, and cannot be excluded from the subject of sanitary reform. Public cleansing is closely allied to public health, and its efficiency undoubtedly tends to lower the zymotic death rate, and promote the general health and comfort of the citizens.

For this reason, therefore, the following observations regarding the scavenging of Dublin, and our general experience of cleansing work may be of some interest to the Sanitary Institute of Great Britain.

To those connected with cleansing or sanitary work, it is gratifying to remember that the illustrious Pericles was chief scavenger of Athens. On assuming this position he stated that

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if he could not derive dignity from the office, he would confer dignity upon it. Unfortunately history gives us no record of his experience.

A distinguished modern sanitarian describes perfect scavenging as "the immediate removal of all matter liable to pollute earth, air, or water."

Dirt in a large city is certainly in the wrong place, the difficulty is to find the right place and remove it thither without delay, in the least objectionable manner and at the least possible cost. Each city must solve this problem for itself, according to its peculiar circumstances—its situation, water supply, sewerage, and the habits of the population must all be considered.

In Dublin all these points were amply and ably discussed at the sittings of a Royal Commission in the year 1879. In the report of the Commissioners, the state of the tenement yards and the efficiency of the then existing scavenging arrangements, is referred to in anything but complimentary terms, and one of their recommendations was, "That the entire scavenging of Dublin, both public and domestic, be undertaken and carried out by the Corporation."

Subsequently the cleansing committee was formed, action was promptly taken, and the public scavenging was re-organised. Loans were obtained, ground was acquired, stables and other offices were built, horses and plant were purchased, and in 1882 the domestic as well as the public scavenging of the city was undertaken.

The city of Dublin includes an area of 3,754 acres, and contains a population of 250,557, or 65·8 per acre, the assessable value may be taken at £652,000, one penny in the pound producing, in round numbers, £2,450. The cleansing of the city, public and domestic, cost in 1883, £26,745, and at present 440 men and 102 horses are employed in the work.

The new premises forming the head-quarters of the cleansing department are centrally situated, having a frontage on Wood Quay, and extending in rear to Winetavern Street.

The buildings include the superintendent's offices, foremen's dwelling houses, stabling for sixty horses, forage lofts with steam power for preparing the forage, cart sheds, goods stores, also joiners, cartwrights, smiths, farriers, saddlers and mechanics' workshops, with muster-room and lavatory for the workmen. The amount expended on the purchase of the site, the erection of buildings, and paving work, has been £6,350.

We have also stations at Stanley Street, Caroline Row, Marrowbone Lane, and Hanover Street, situate respectively in N.W., N.E., S.W., and S.E. districts of the city. At these four stations fifty horses with corresponding plant are kept, but

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all are managed from Wood Quay, with which they are in telephonic communication.

The cleansing of the city, under one management, is divided into three sections, viz: (1) the cleansing of the tenement yards; (2) street scavenging; (3) domestic scavenging, or house-refuse and night-soil removal.

The city is divided into eight cleansing districts, which apply to all the three sections of scavenging.

1. *The Cleansing of the Tenement Yards and Urinals.*—In this, the last organised section of the work, we have sixty-nine men employed, including foremen. Their working hours are from 6 in the morning till 11, and from 12 noon till 5 p.m. Each man has his own beat, which includes on an average about 90 yards, and each ganger is responsible for all the yards in his district. In this way the 5,000 tenement yards, which are common to a number of families, are swept daily, and, at the same time, the closets are mopped and washed. We also wash with hose some of the filthiest courts and yards which are sufficiently well paved to admit of this highly commendable process.

The habits of the occupiers of tenement houses are a source of difficulty in the cleansing of all large towns; but it is unreasonable to expect people to be cleanly in their habits unless their surroundings are kept in a tolerable state of cleanliness; and, until a tenement yard is properly sewered and paved, it is almost impossible to keep it as clean as it ought to be.

In Dublin, I am glad to say that a decided improvement is apparent in the condition of the tenement yards since we undertook the daily cleansing of them. To further improve the habits of the occupiers of these tenement houses, the power vested in the sanitary authority of the Scottish metropolis by the Edinburgh Municipal and Police Act, 1879, and the Edinburgh Municipal and Police Extension Act, 1882, would, in my opinion, be of immense service to us in Dublin. By Section 98 of the above Act, 1879, power is given to prosecute the occupier of a tenement house in cases where refuse has been thrown upon the surface of the yard, although the actual offender has not been discovered. I now quote it.

"Every person who shall throw or cast from any window or other opening or place above the street level of any house or building any water, soil, dirt, filth, or any offensive matter or thing into or upon any street or court, back ground, garden, or place, shall be liable to a penalty not exceeding forty shillings; and in the event of the person committing any such offence not being discovered, the occupier of any room or other apartment, or passage from the window or other opening or place of which

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any such water, soil, dirt, filth, or any offensive matter or thing shall be thrown or cast, shall be liable to the said penalty."

In Section 41, Sub-sections 3 and 5a of the Edinburgh Police Extension Act 1882, there are also excellent regulations regarding the house refuse from tenements, and the regular washing of the stairs of these dwellings.

2. *Street Scavenging and Watering.*—There are in all about 113½ lineal statute miles of streets within the municipal boundary of Dublin.

Of these there are—

20¼	miles of	new set paving.
22¾	„	boulder do.
70½	„	macadam.

On account of this extensive area of macadamised streets we have a larger amount of dust and mud to contend with in proportion to the population than most cities.

In 1883, 27,000,000 gallons of water were spread on the streets, and 100,748 loads of scavenge were removed, 36,645 from paved streets, lanes, and markets, and 64,103 from the macadamized streets and roads.

In this section of the work 224 men, including foremen, and 63 horses are employed.

We have ten horse-drawn sweeping machines in use, with which all the principal streets are swept by night; the back streets and lanes are swept with hand brushes by day.

The horse-brushes turn out at eleven o'clock at night, and the day scavengers commence work at 4.30 in the morning, the carts turning out promptly at five o'clock to water or scavenge as required.

All the first and second class streets are cleansed daily, and the third and fourth-rate streets are done three times a week. The asphalted streets are washed regularly with hose.

The lanes of Dublin require and receive quite as much attention as the main streets, on account of the quantity of vegetable and other refuse which is thrown upon them. The abatement of this nuisance, however, has of late received considerable attention from the Chief Commissioner of Police.

3. *The Removal of Night Soil and Domestic Refuse.*—This section of the work commenced in May, 1882, is now fully organised, and a staff of 110 men, including foremen, and 39 horses are employed.

During the present year the quantity of house refuse removed per day has exceeded 250 tons.

The cleansing of the ashpits is done by night—that is between

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the hours of 10.30 p.m. and 9 a.m., and the men are paid according to the weight of refuse removed.

When the domestic scavenging was undertaken there were in the city 18,165 ashpits, of which number more than one-half were wet sunken pits, and in addition there were 11,577 common privies.

From more than 10,000 ashpits the refuse could be removed through the house only, and from 13,000 ashpits the refuse had to be carried out in baskets or buckets.

The regular and systematic cleansing of these places revealed in full the necessity for structural and other improvements.

The abolition of privies in all the main streets was first accomplished, and subsequently a system for the daily removal of the shop sweepings and house refuse therefrom was organised. Galvanized iron dust-bins, suitable to the respective requirements of the shopkeepers and householders, are supplied by us at cost price. Three different sizes of covered bins are used for the collection and removal of shop sweepings and dust by the morning bell-carts, and an oblong open bin is supplied for the reception and removal of house refuse.

We have already more than 2,000 dust-bins in regular use, and the number is rapidly increasing. Having insisted on the use of dust-bins of a uniform pattern from the commencement of this branch of our domestic scavenging, Dublin has been spared the nuisance caused by the use of orange boxes, tea chests, hat boxes, and such articles, which are still commonly exposed with house refuse in nearly all large cities.

We have thus two systems in operation: portable dust-bins and fixed ash-bins or ash-pits. The former system is extending in the centre of the city, where fixed ash-pits are being gradually abolished. The latter system however predominates, and the great bulk of the domestic refuse of Dublin is still collected in ash-pits. Much has been done to improve these ash-pits during the last two years, but I freely admit that there is still abundant room for improvement.

Soon after the Cleansing Committee commenced the domestic scavenging, the Public Health Committee undertook the abolition of privies, and the general improvement of the sanitary accommodation provided for the citizens, more especially in the yards attached to the tenement houses. The systematic reconstruction of closets and ash-bins on a uniform plan approved by the Corporation is now in progress.

During the last two years about 3,000 privies have been abolished, and a corresponding number of water closets have been erected; there are now about 18,000 water closets in use,

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so that in a few years more we hope to see Dublin a water-closeted city.

The removal of excreta by water carriage has its weak points like any other system, still I feel certain that it is the best that could be adopted for Dublin, considering its proximity to the sea, its abundant water supply, and efficient system of main sewers.

While the excreta, the most noxious, but at the same time the most valuable of the domestic refuse, is thus got rid of by means which sanitary science considers the cleanest, quickest, and best, the remainder of the house refuse becomes to a large extent valueless as manure, and a large portion of it is altogether unsaleable.

We shall now give a brief description of the arrangements for the disposal of the city scavenge, saleable and unsaleable.

The total quantity of scavenge removed during the year 1883 was as under:—

Scavenge from Paved Streets, Lanes, and Markets	36,645	loads.
Do. from Macadam Streets and Roads	64,103	„
House Refuse from Ash-pits	71,476	„
Do. from Portable Dust-bins ...	2,201	„
Total	174,425	loads.

Our saleable scavenge or city manure is composed of the scavenge from paved streets, lanes, and markets, the wet ash-pit refuse and night-soil, and amounts in round numbers to 75,000 loads per annum.

Our unsaleable scavenge, or city refuse, consists of the scavenge from macadamized roads, dry ash-pit refuse, and the contents of dust-bins, amounting in all to no less than 100,000 loads yearly.

To dispose of the saleable scavenge advantageously, as it is produced, in the least objectionable manner, and to get rid of the unsaleable scavenge by the most rapid, efficient, and economical method possible, a variety of circumstances must be considered.

The disposal of the saleable scavenge of any city depends largely on the agricultural area to which there are means of transit, and to which it can be despatched at a profit.

In Dublin we are confined to the farmers around the city, who draw the manure in large quantities from the depôts, and to those having land convenient to the canals, by which we now despatch a considerable quantity annually. But we have no railway traffic in manure, and on the whole the demand for

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city manure in the country districts is slow, and the prices obtained for it so very low, that it was apparent, from the commencement of the domestic scavenging, that any scheme which would involve the riddling of the refuse, and its preparation as a manure, would not yield a revenue which would justify the expenditure.

Besides, in the Dublin refuse the proportion of heat-giving cinder is so very small, that it would be inadequate to produce the steam-power required for the riddling and preparation of the manure as carried on in Glasgow and Manchester.

I shall now describe briefly the arrangements at one of our manure stations.

Stanley Street, which is the only manure depôt on the north side of the Liffey, was purchased in 1882, and extensive buildings have since been erected there by the cleansing committee. On the east side of the ground is the stable yard, with stables for eighteen horses, forage and harness rooms, cart-shed, foremen's offices, and stableman's house.

At the entrance gate is the yardman's house and weigh-office, which has telephonic connection with the offices of the department on Wood Quay. From the weigh-bridge a paved inclined roadway, thirty feet in width, provides easy access for the dust-carts to the upper floor of the manure-shed, which covers a space 154 feet in length and 78 feet in width. Within this building the refuse is tipped, mixed, and again dispatched, by the farmers' carts, which remove in rotation the manure from the three bays into which the ground floor is divided. Cinders and other combustible refuse, valueless as manure, are passed through the cremating furnace, which stands conveniently in a separate building at the end of the manure shed. Old iron, leather, bottles, &c., are also collected for sale.

In order to prevent the escape of noxious odours, special attention has been given to the ventilation of the main building. The foul air is conveyed under the bars of the cremating furnace, and is thus purified before passing into the chimney, which is 140 feet in height.

The yards, incline, and floor of manure-shed are paved with granite sets on a concrete foundation, so that the whole premises present a clean and orderly appearance. To the work as now carried on there has been no complaint, nor is there the slightest cause for objection. The amount expended at Stanley Street on the purchase of the ground, erection of buildings and paving, has been £7,850.

The saleable refuse dealt with at our three manure depôts forms about three-sevenths of the whole scavenge, so that we have about 100,000 loads of unsaleable scavenge to dispose of

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annually. Regarding this class of refuse, the consideration is what is the cheapest and best method of getting rid of it at once and for ever? I am glad to state that we have decided to convey the Dublin unsaleable refuse to sea in a hopper barge.

The cost of this vessel will be £5,950. She is specially designed to meet all our requirements, and is now almost ready for launching. A suitable and convenient berth has been obtained on the river near the Swivel Bridge, and is now dredged out to the required depth. A jetty, 120 feet in length, and 16 feet in width, has been there built, and upon it a five ton steam crane with novel and efficient loading appliances has been erected for the purpose of transferring mud as well as dry refuse direct from the scavenge carts to the barge, with which we propose to commence operations in a few weeks.

The following are the principal dimensions of the vessel:—

	Ft.	In.
Length	116	6
Breadth, moulded	30	0
Depth moulded, amidships... ...	12	0
Length of hopper	50	0
Breadth „	18	0
Sheer, forward	2	9
„ aft	1	6
Camber of deck	0	6

She will carry about 340 tons of refuse, and the trip to the place of deposit off Howth and back will take less than five hours in average weather. By this means the refuse will be conveyed to its ultimate destination at an estimated cost of fivepence per ton. Considering all the circumstances, I think it will be admitted that we have adopted the most expeditious, efficient, and economical method possible for the disposal of our unsaleable refuse.

Every city must adopt the means best suited to its circumstances and requirements, but I believe other water-closeted seaport towns might safely follow the course adopted by Liverpool and Dublin for the disposal of city refuse.

In an age remarkable for the communization of the resources of civilization it is surprising to find how little has actually been done even in our wealthiest towns to provide the working population with suitable dwellings, having the sanitary accommodation actually necessary to cleanliness and compatible with decency.

In nearly all our large cities, Dublin not excepted, the material change caused by the exodus of the better classes to rural or suburban residences has necessitated alterations in the

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urban houses now occupied by the lower classes, and more especially improvements in the sanitary accommodation provided for them, but in many instances these improvements have not been effected.

The drains, closets, ash-bins, water-supply, and paving in the yards connected with the tenement houses forming the dwellings of the working population are frequently defective or inadequate.

In every tenement yard there ought to be (1) a proper house drain not less than 6 inches in diameter, carefully laid with a proper fall to the main sewer and properly jointed; (2), a large gully trap connected with the sewer for the reception of slops; (3), two closets, one for each sex, with a cistern capable of containing not less than 4 gallons of water; (4), a covered ash-bin not less than 5 ft. by 4 ft. by 2 ft. 6 ins.; (5), an impervious surface of asphalte, or paving sets grouted with tar, laid with a proper fall to the gully grate; and (6), in addition to the ordinary water tap, a tap to which a hose can be attached for washing out the yard.

Simple and necessary as these requirements may seem, so far as my experience goes there are few tenement yards in which all of them have been provided.

With regard to water-closet accommodation, in the absence of compulsory power it is a difficult matter to induce landlords to go to the expense necessary to provide good substantial closets, with cisterns sufficiently large, and adequate sewers laid as they ought to be; when all these have been provided, it is still more difficult to train a population to use water-closets without abusing them; and it is discouraging to house-owners to find closets broken or choked with rags or straw soon after erection. Yet withal we regard the water-carriage system as the cleanliest and best that can be adopted in a city circumstanced like Dublin, but at the same time we regard strict supervision over the erection of the closets with their sewers and water connections as an absolute necessity.

A large gully trap conveniently situated in every tenement yard is also requisite, and unless such is provided, the slops must find their way into the ash-bin, as they frequently do.

I have said that we have both fixed ash-bins and portable dust-bins in use in Dublin, and the latter system is rapidly extending. The daily removal of house refuse by portable dust-bins of a uniform pattern is a system admirably adapted for the removal of shop sweepings and dry house refuse in the main thoroughfares, and it also works well where you have a population living in self-contained houses or cottages, each provided with a water-closet. But from experience in Glasgow

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and Dublin, I consider it unsuitable for the lower class tenement houses, where in many cases the people have not yet learned to put the slops into the sewer, and the solid refuse into the ash-bins.

The constant exposure of filth in the number of bins requisite for a large tenement, cannot fail to have a demoralizing effect on the occupiers, and besides it is much more difficult to keep the yard or court clean with dust-bins than with a larger fixed ash-bin.

The fixed ash-bins now being erected in the tenement yards of Dublin, at the instigation of the Sanitary Authority, are calculated to contain the house refuse for one week or thereabouts.

The walls are 9-inch brickwork, the roof galvanized corrugated iron or slates, the floor is from 3 to 6 inches over the level of the yard, and the floor and sides are rendered water-tight with cement.

Its advantages are (1) a child can throw refuse into it, (2) it is easily cleansed, (3) no filthy water is allowed to escape and permeate the subsoil, and (4) in the event of portable bins being used at a future date, it will form a stand and shed for them.

Necessary as the sewering and paving of private yards undoubtedly is to domestic cleanliness, the proper formation and drainage of the public streets in like manner must invariably precede efficient street scavenging. I regard a macadamized street, suitable as it may be for light traffic, as quite out of place in the centre of a large city, where no amount of attention will keep it entirely free from its usual accompaniments of dust and mud.

A street calculated to sustain heavy traffic should have a good foundation of concrete carefully laid to the required levels. If the surface is formed of granite sets these should be carefully dressed, so that they can be placed close together, and the interstices should be grouted with cement or pitch.

Wooden blocks, well laid and grouted, also make a good street surface, less noisy and more pleasant than granite, for a city that can afford to pay for their frequent renewal. The blocks should be carefully selected before creosoting, otherwise they will wear unevenly.

Provided with a good surface of granite or wood, street scavenging, though requiring constant attention, is comparatively an easy matter, and can be efficiently accomplished at a moderate cost.

The vegetable supply of Dublin is a matter which also affects our cleansing operations. An excellent supply of fresh vegetables has created a large demand, and they form an important

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item in the diet of the lower classes. But, unfortunately for the cleansing department, the cabbages and other vegetables are brought into the city wholly untrimmed, and consequently in the height of the vegetable season we are called on to remove per week not less than 200 loads of vegetable refuse. The prompt removal of all vegetable, fish, fruit, and similar refuse, is a most necessary part of city cleansing, but there is no valid reason why the vegetables should not be trimmed in the country, and we are glad to state that a scheme for providing a wholesale market for the sale of vegetables under the control of the Corporation is now under consideration.

The work of our cleansing department, thus described, we do not by any means consider perfect; indeed, no one is more sensible of its defects than the writer of this paper. Still, we have carefully considered and earnestly endeavoured to decide upon the best lines of action, and working patiently upon them during the last three years in our untiring desire to render dear Dublin less dirty, we are glad to believe that our efforts have been not entirely without success.

[*This discussion applies to the preceding three papers by* Professor Henry Robinson, Mr. W. Eassie, *and* Mr. J. Young, *which were discussed conjointly.*]

Mr. C. P. Cotton, M.Inst.C.E. (President of the Section), in opening the discussion, said that he had been greatly struck by Prof. Robinson's allusion in his paper to the relation between ensilage and sewage farms, leading to a probable solution of a common difficulty in connection with this method of disposal of sewage. In Mr. Eassie's paper the difficulty of removing refuse had been very ably dealt with. He had also been very much interested by the relation of the facts which were contained in the paper of Mr. Young, who had handled the subject in a very able manner.

Mr. W. C. Sillar (London) protested against any disposal of sewage being considered satisfactory which did not provide for the preservation and utilisation of its valuable component parts. The systems of Nature are, he said, complex, and we cannot violate one without mischief to all; and it is a flagrant violation of a fundamental law of Nature when we neglect to restore to Mother Earth what she has so liberally given to us, when we have received it, enjoyed it, and have no further use for it. The throwing it away into the sea is wilful and wicked waste—proverbially the parent of woeful want, that now frequently threatens us. The possibility of this utilisation is not now a question of theory, it is one of fact. It has been demonstrated successfully for eight years at Aylesbury, in Buckinghamshire, where the

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sewage is purified, and all that otherwise would have been offensive is arrested, and the effluent water allowed to run to its proper place, the river, whilst this matter, so arrested, is preserved in a portable and inoffensive condition for use in the agriculture of the country. We sometimes hear the cost of this objected to, but when this is compared with the cost to the community of *not* doing it, it sinks into insignificance. It is seriously proposed to throw the whole sewage of London into the sea. This sewage would produce 220,000 tons of native guano each year. This manure is readily bought by farmers at £3 10s. per ton, and declared fully worth it. This would be £770,000 per annum gained by the country, and this gain would not be modified by any reduction of market price. The reduction of this by one half would not interfere with the manurial power, but unquestionably it would afford immense relief to our sadly and terribly overweighted agriculture.

Mr. H. P. Boulnois, M.Inst.C.E. (Portsmouth), said that the question as to the disposal of sewage had always been one which had excited the attention of alarmists. There was no doubt that sewage if passed into a river in a crude state did pollute it, but with a little preparation there was no doubt that it would be eventually purified by the action of the river mile by mile as it went along. Fourteen miles above the city of Exeter the town of Tiverton passed its sewage into the river Exe, and analysis showed that the water became gradually purified, until a few miles below the town it was almost quite pure. They had not yet discovered any process by which the disposal of sewage could be made really profitable to the public, and the whole question was one entirely of cost. With regard to Mr. Eassie's paper he believed that everything was pointing towards cremation as the best means of disposing of house refuse.

Mr. Jones expressed the pleasure which he had derived from hearing the excellent paper of Prof. Robinson read. Many years ago they had heard a good deal about irrigation and the utilisation of sewage: of its value and the profits to be derived therefrom. Now, however, these fictions had been exploded, and they all knew pretty well the real facts of the case. These works could not be made to pay sufficiently to justify such a large expenditure of money. He expressed himself greatly pleased with the general state of cleanliness which Dublin presented when compared with other cities which he had visited.

Mr. Parke Neville, City Engineer to Dublin, was of opinion that the great difficulty in dealing with sewage was one of cost. In preparing it for manure a considerable expenditure was necessary, and great diffilcuty would be experienced in making it a paying commodity.

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On "The Water Supply and Drainage of small towns in Ireland," by F. F. MacCabe, F.C.P.I.

The Public Health (Ireland) Act of 1878 divides Ireland into urban and rural sanitary districts. It declares the following to be urban districts: the City of Dublin, Towns corporate —in these the Corporation is the sanitary authority; Towns with a population exceeding 6,000, having Commissioners under the Act 9 of George IV.; Towns with a population exceeding 6,000, having Municipal Commissioners under the Acts 3 & 4 Vic., cap. 108 (the Municipal Corporations (Ireland) Act); Towns with a population exceeding 6,000, having Town Commissioners under the Acts 17 & 18 Vic., cap. 103 (the Towns Improvement (Ireland) Act); and, lastly, Towns or Townships having Commissioners under local Acts. In all these the commissioners, the municipal body, and the town or township commissioners, are the sanitary authority. The Public Health Act also contains a provision (section 7) enabling the Local Government Board for Ireland, by Provisional Order, to constitute any town or township having town or township commissioners, under any Act, an urban district; and provision is made for the transfer to any urban sanitary authority of the jurisdiction exercised by county grand juries over roads, bridges, and footpaths, within such urban sanitary district (section 206).

From these provisions it will be observed that all towns having a population not exceeding 6,000, or not possessing township commissioners under local Acts are, for sanitary purposes, under the jurisdiction of the Boards of Guardians of the Unions within which they may be situated, the whole of Ireland being divided into 163 poor law unions. The board of guardians of each union constitutes the rural sanitary authority.

Urban sanitary authorities have power to appoint committees to carry out the purposes of the Public Health Act—no similar power is given to rural sanitary authorities.

The expenses of urban sanitary authorities in carrying out the provisions of the Public Health Act are to be provided for, in the case of a borough, out of the borough fund or rate, and in other cases, out of any rate leviable by the town or township commissioners throughout the whole of their district. (s. 226). Urban authorities also possess the important power of declaring certain expenses to be private improvement expenses, and to levy them on the occupiers of the premises in respect of which they have been incurred, in the shape of a private improvement

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rate—the occupier in such cases can deduct three-fourths of the rate from the rent payable to his landlord (ss. 229, 230).

The expenses of rural sanitary authorities, in other words boards of guardians, in the execution of the Act, are divided into general expenses and special expenses. General expenses may be described as expenses connected with the sanitary staff, and are to be paid out of a common fund raised out of poor rate (s. 232). Special expenses include the principal sources of sanitary expenditure, such as water supply and sewerage works, and must be charged upon a contributory place or places, either the dispensary district, the electoral division, the townland, or part of the townland, and the power of determining the area of charge in each case is vested in the Local Government Board for Ireland (s. 232).

I have thought it desirable thus briefly to refer to certain provisions of the Public Health Act, which have an important bearing upon the subject, to which I ask permission to draw the attention of this Congress.

Of towns in Ireland, by far the largest number are so situated with respect to population and local government, as to come for all sanitary purposes within the jurisdiction of boards of guardians as the rural sanitary authorities of the districts within which they happen to be included. Except where the population of a town exceeds 10,000, there is no provision in the Poor Law Acts for special representation of the population by division of the town into wards (2nd Vict., c. 1, s. 2). It thus happens that urban populations which are large enough to suffer from the absence of sanitary works, such as water supply, sewerage, and drainage, are not represented at the meetings of the sanitary authority (the boards of guardians) in proportion to population, or in a measure bearing any relation to their sanitary requirements. Poor law representation is in fact founded more upon a territorial basis, having the electoral division as its unit, than with any regard to the distribution of population. It appears to me that whenever the inhabitants of any place, whether it be called a town or a village, exceed in number 500, some arrangement for a supply of pure water, taken from outside the inhabited area, becomes necessary; some drainage works are required, and some general plan for the removal of the sewage, or for the periodical removal of excreta from the dwellings, is much to be desired. When the population of any town exceeds 6,000, the Public Health Act imposes upon the urban sanitary authority the obligation of providing adequate water supply, drainage, and sewerage. When, however, the population exceeds 500 but does not exceed 6,000, the small urban districts included within these limits must, except in the

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few cases in which orders have been issued under Section 7 of the Public Health Act, depend upon the boards of guardians, as the rural sanitary authorities, to provide for their water supply, their drainage, and their sewerage, or other means of filth removal.

There are 338 small towns in Ireland, with a population between 500 and 6,000, thus depending upon rural sanitary authorities to provide for their wants, and the object I have in view in submitting this paper is to draw attention to the actual condition of a large proportion of these towns, and to elicit an expression of opinion on the part of the Congress as to the means which would appear best calculated to place them in a fairly satisfactory sanitary condition. At present the vast majority of these small towns depend for their water supply upon wells sunk within the inhabited area, and therefore exposed to all the dangers incidental to the consumption of a water supply drawn from a more or less filth-polluted sub-soil. For drainage purposes the small towns depend upon the water-courses constructed under the roadways by the grand juries of the counties. These grand jury drains are almost invariably constructed with side flags or loose stones resting on the earth, and are covered in by flags across the top. They generally lie under the channel gutters, and empty their contents at intervals into open ditches adjoining the roadway. Inasmuch as grand juries possess no statutory powers to construct proper sewers, the county drains are intended to carry off only surface and storm waters so as to keep the roadways properly drained. On country roads they answer all the purposes for which they were designed, but when the county road passes through a small town where there are houses of the better class, the practice has become very general for householders to put up water closets and to construct a house drain, which is carried as far as the county water drain, and allowed to discharge sewage matter of every kind into such county drain. Having regard to the mode of construction of these county drains, which are insufficiently flushed by occasional storm water and cannot be self-cleansing, the inevitable result of this practice is, in a short time, to block the drain. It is then reported to the board of guardians, as the rural sanitary authority, that the so-called sewers in the town are stopped. The board of guardians disclaim responsibility, as there are, properly speaking, no sewers in the town; and as the county grand jury have jurisdiction over the roadway, the subject is referred to the county surveyor. This officer, on behalf of the county grand jury, generally disclaims responsibility, alleging that the county drains having been improperly made the receptacles for sewage matters, have become

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sewers, and ought to be looked after by the sanitary authority, in which all sewers are vested; and it thus becomes difficult to decide who is to remedy a condition of affairs which constitutes a very serious nuisance. If, as sometimes happens, a board of guardians are willing to improve the construction of the county drains within the limits of the town, and to attempt to render them self-cleansing, they have to encounter serious difficulties. The sewerage of even a small town requires to be undertaken as a whole, with due regard to levels and to the provision of some outfall which shall not pollute a watercourse. This is a work involving an outlay which is considerable in relation to the assessable value of the town. If the board of guardians decide upon a system of filth-removal by other methods than sewers, the establishment and working of such a system requires a sanitary staff and a constancy of supervision to which their administrative resources are quite unequal, and it further requires an amount of intelligent co-operation upon the part of the inhabitants which it is a work of time to establish. Boards of guardians have also to my knowledge been advised by competent authority that a system of sewerage will not work in an efficient manner unless there is a water-supply much more abundant than that furnished by a few wells within the inhabited area. If, therefore, they are disposed to construct a system of sewers, they feel constrained to undertake at the same time a pipe water-supply. The amount of outlay involved alarms them, and, bearing in mind that the great majority of the guardians have no direct interest in providing for the sanitary requirements of urban populations which happen to be included in the union, they are not disposed to give the subject the amount of sustained attention necessary for perfecting plans and applying for the loans required. When the question of outlay comes to be considered, boards of guardians are also generally disposed to confine the area of charge as closely as may be possible to the neighbourhood which is expected to derive benefit from the works to be undertaken. The advantages to be derived from sewerage works are no doubt directly confined to the town itself, and the Local Government Board for Ireland, in determining the area of charge for such works, have, as a rule, adopted the recommendations of the guardians, and confined the area of charge to the townlands, or parts of townlands, upon which the town is built. In considering areas of charge for water-supply, they have generally encouraged boards of guardians to recommend much larger areas, inasmuch as the benefits conferred by an abundant water-supply make themselves felt over a considerable district, extending on all sides of the town thus provided for. In practice, however, it is found that

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boards of guardians, acting as rural sanitary authorities, evince an almost insuperable unwillingness to undertake both water-supply and sewerage works for the benefit of those small urban populations entrusted to their sanitary supervision, and it must be added that the townspeople encourage this apathy by their own opposition to any undertakings which will involve considerable outlay and consequent taxation.

I have had considerable experience of boards of guardians acting as rural sanitary authorities in Ireland, and as the result of personal intercourse with such authorities, extending over many years, I am glad to be able to bear testimony to the readiness they have evinced to make due provision for the protection of the public health, whenever they have received any encouragement from the persons who would be called upon to bear the cost of the improvements. I have, however, found that when a considerable outlay became necessary, with the object of placing one of these small towns in a satisfactory condition as to drainage and sewerage, the assessable value of the property within the townland or townlands on which the town was built was so small that for public sewers constructed out of a loan advanced, say for 35 years, the annual charge necessary to meet interest and sinking fund was so great that householders recoiled from the prospect of the liability involved. The boards of guardians thus often found the most strenuous opponents of such undertakings in the persons who, from a sanitary point of view, would be most benefited by the execution of the works. With regard to schemes for the supply of pure water collected at some spot in the neighbourhood of the town, removed from sub-soil contamination, and thence conducted by a system of pipes into the town, the area of charge may be much larger than that usually adopted for sewerage; but it is to be observed that with the extension of the area there is a corresponding enlargement of the circle from which objections may arise—ratepayers outside the town objecting to become contributory towards an outlay from which they conceive that they derive no immediate advantage. There can be no doubt that very imperfect knowledge is possessed by boards of guardians on the subject of the economy of sanitation as a security against disease, suffering, and death. They have never had any precise information placed within their reach respecting the amount of preventable disease, suffering, and death, with consequent loss of wage-earning or productive power, which may be avoided by the provision of suitable drainage and pure water. They have regarded only the direct cost, without taking into account the indirect gain, which I believe would fairly more than counterbalance the much dreaded taxation. Some most interesting light has been

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thrown upon this aspect of the question by the publication in the Reports of the Medical Officer of the Local Government Board for England of the amount of sickness and suffering as disclosed by the death-rate due to preventable diseases *before* and *after* the execution of sanitary works in certain English towns.

The practical difficulty which obstructs the path of progress in the direction of the sanitary improvement of small Irish towns in respect of water-supply and sewerage is really the general unwillingness to bear the cost—the incidence of taxation exciting opposition from its burthen when the area of charge is limited, and from its including those not directly benefited when the area of charge is more extensive. The question then suggests itself whether it may not be possible so to modify the existing application of the provisions of section 232 of the Public Health Act of 1878 as to diminish the force of this opposition. I think this may be accomplished. As section 232 is at present applied to special expenses, areas of charge press equally upon all the rated occupiers within such areas. It appears to me that this principle might admit of modification. If the rural sanitary authority decide that the area of charge for water-supply of a town shall be the electoral division within which that town is situated, it will be found that the rated occupier living in the town will have to pay exactly the same amount, in the shape of a poundage rate upon his valuation, as the rated occupier who lives at the most distant part of the electoral division, although the townsman uses the water at all hours of every day, and the dweller at the end of the electoral division perhaps comes into town only once in the week. It appears to me that the cost of the water-supply might be divided so as to fall in unequal proportions upon the contributory area. I can see no reason why, for instance, three-sixths (or one-half) of the total poundage rate should not fall upon the townlands on which the town is built, two-sixths upon townlands within a certain distance of the town, and the remaining sixth upon the more distant parts of the electoral division. In the same way, with regard to sewage works, I can see no objection, in principle, to the adoption of some sliding scale of assessment, by which the heaviest part of the charge would be made to fall upon the town, and a certain charge, decreasing *pari passu* with the increase of distance from the centre of population, imposed upon an area much more extensive than the town itself.

I have referred as shortly as I could do, consistently with a clear statement of the facts, to the actual position of the small towns of Ireland with respect to the water-supply and sewerage, and I am anxious to obtain an expression of the opinion of the

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sanitary authorities I have the honour of addressing as to the best means for dealing with a subject which I have found to be one of great difficulty. I have purposely refrained from discussing the best methods of dealing with town sewage, which have been suggested or put in operation in large centres of population. These methods are dealt with in a manner which leaves nothing to be desired, in the lucid report of the committee appointed in 1875 by the Local Government Board for England, under the chairmanship of the President of this Congress. The report of that committee seems to me to be applicable to towns the governing bodies of which are themselves the sanitary authorities within the municipal, or town, or township boundaries. My remarks have been confined to the small urban populations, ranging between 500 and 6,000, which, for sanitary purposes, are subject in Ireland to the jurisdiction of boards of guardians, acting as rural sanitary authorities.

Mr. George Hodson (Loughborough) thought that the general district about such towns as those referred to in Mr. MacCabe's paper should contribute to these rates when there was a likelihood that they would in time require to have provision made to supply them, in the event of the town enlarging. A certain area in the district, he was of opinion, should contribute towards the carrying out of sanitary works in the town.

Mr. R. O'Brien Furlong (Dublin) said that in Ireland the Public Health Act of 1878 gave power to the Local Government Board, on the application of the sanitary districts affected, to combine such districts, in cases where it was found that singly they would be unequal to the burden which would be imposed upon them, in bearing the cost of sanitary works. He cited instances in which poor law unions and electoral divisions had been amalgamated in this way, for the purpose of bearing unitedly the cost of sanitary works.

Mr. G. J. Symons, F.R.S. (London), expressed the pleasure which he had derived from hearing Dr. MacCabe's ably-written paper. The subject was one of very great importance, and deeply concerned the inhabitants of the smaller towns in Ireland. It was a matter of the very gravest importance, from a sanitary point of view, to ensure that the inhabitants of these towns should have a proper water-supply, and he was of opinion that where they were unable to bear the cost themselves, a portion of the expense should be borne by the district immediately about the town.

Mr. L. L. Macassey (Belfast) thought that the best way of meeting the difficulty was to make the centres in such cases more local. Boards of guardians were too unwieldy to work out sanitary matters efficiently.

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Guardians were elected for a large district, and the villages and small towns in such districts were only indirectly represented by a farmer in the vicinity, who had a strong dislike to spending money. Under the present state of things it was practically impossible to get any improvements made in the small towns and villages. Committees might perhaps be formed to deal with the cases brought forward by Dr. MacCabe; these committees to be made up of local persons, and to have powers in their district somewhat similar to those of town commissioners in the larger towns. Some change was required in the present state of things if our small towns and villages were to share at all in the advantages of sanitary improvements and progress.

Mr. H. H. Collins, F.R.I.B.A. (London), said that the question raised was a most important one, and would require to receive every attention.

Mr. C. P. Cotton, M.Inst.C.E. (President of the Section), pointed out the difference between the English and Irish Public Health Acts in that in striking rates for special expenses on "contributory places" under the English Act the occupier of any land used as arable, pasture, or meadow ground only, or as woodlands, market gardens, or nursery grounds, &c., is assessed in one-fourth part only of the rateable value thereof, whereas in Ireland the occupier of such properties is rated for the full value; this has an important bearing on the question of fixing the area of charge.

Mr. Stirling, Mr. Gardiner, and Dr. J. Byrne Power also joined in the discussion.

Dr. MacCabe (Dublin), in replying, thanked the members of the Congress for the attention they had bestowed upon his paper.

Sir Robert Rawlinson, C.B. (President of the Congress), wished to modify an expression of opinion which he had given on a previous day, and which was liable to some misconception. He was, as a general rule, opposed to the use of small pipes for the conveyance of water to towns with populations of and above two thousand, although such pipes might be more economical than larger ones. He was opposed to the use of a cast-iron pipe which was anything less than three inches in diameter. At the same time, in certain cases, there was no doubt that isolated houses and small farm residences might, in cases where there was water in the district, convey the water by a pipe 1½ inches in diameter. He would not, however, recommend the laying down of lead pipes, as they might be there for a short time, but very likely would have disappeared next day.

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On "Isolation versus Ventilation," by H. PERCY BOULNOIS, M.Inst.C.E.

ANALOGOUS to the question of the disposal of sewage is that of the danger arising from it as it passes along the public sewers, and the object, therefore, of this paper is to open up discussion upon the somewhat vexed points as to the best methods at present known for the so-called ventilation of our sewers, as to what methods have hitherto been attempted, and whether these attempts have been successful. An endeavour will be made to show that the modern practice of openings in the centres of the streets is unsatisfactory and unnecessary, and that it is a far more important sanitary measure to isolate the house from the sewer by means of simple and effective traps, than to make these openings in the sewer, and that if this isolation is perfected, the sewer ought to be buried completely out of smell as well as out of sight, which is now unfortunately far from being the case.

The present system of ventilation seems to have originated about the year 1830, when grievous complaints were constantly made by the inhabitants of the City of London that great stenches arose from the gully pits at the sides of the roads; these upon being trapped caused the foul air to pass through the untrapped house-drains into the houses themselves, and the remedy proved more unsanitary than the original cause of complaint. The cure that then immediately suggested itself was the relief of the pressure of the foul air by making openings in the crown of the sewer, carrying shafts to the centres of the roadway and protecting these shafts with iron gratings, a practice which has been steadily copied since the year 1840.

These openings, however, were speedily found not to be all that was necessary, for in spite of them the foul air still entered the houses through the untrapped drains, and the object had not at all been attained. Consequently traps were introduced in order to break the continuity of the house drain; first, the now old-fashioned brick pit, with slate or stone tongue, called a Mason's trap, and then the syphon; the seal was deepened, double traps were inserted and flaps were placed in different parts of the system in order to secure the isolation of the house. It is only of quite recent date, however, that the real secret of pneumatic separation, or isolation of the house, has been discovered, and this was done gradually—first, the

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cascade action in the trap was introduced, and then the important addition was made of leaving the soil pipe open for ventilation. This was followed by cutting off all connections between the drain and the waste pipes from sinks, baths, lavatories, &c., and causing them to empty on to gratings, and other methods; and then the pneumatic separation was devised, by which fresh air is introduced on the house side of the trap, and a current is thus constantly passing through the house drain, and with the help of the deep trap entirely cuts off the house from the common enemy, the public sewer, and renders it as completely isolated as modern sanitary science can effect.

Owing to the varying level of the fluid in the public sewer, some escape must be provided for the air contained in it, otherwise one or more of the house-drain traps would be unsealed by the air as the fluid rose, and this can easily be effected by carrying a shaft of about 6 inches in diameter from the crown of the sewer near its highest level to some convenient and safe height against an adjoining building. One such shaft for each 200 yards would be sufficient for nearly any ordinary street sewer to relieve the pressure upon the traps until long after the connection of the house-drain with the sewer was below the level of the sewage, and this would meet the requirements of the most violent rain-storm, and prevent the unsealing of the deep sealed traps. Should, however, a trap become unsealed, the open character of the house-drain and the traps of the water-closets, which should be of some simple wash-out pattern, would quite prevent the chance of entry of any of the foul sewer air into the house, and thus the sewer ventilation as it is called becomes perfectly unnecessary.

Before proceeding further to discuss the question, it will be interesting to observe the following chronological list of different methods which have from time to time been suggested or actually attempted, not only for the purpose of ventilating sewers, but also for processes of destruction, retention or harmless conversion of the different gases contained in the sewers.

The list is as follows:—

1840. Open shafts, as already described, were first introduced.

1848 to 1853. Captain Shrapnel made a suggestion that high cast iron cylinders should be constructed over the sewers in which furnaces should be placed to consume the gases.

Messrs. Warr and Armstrong proposed to build domes over the sewers from which pipes should conduct the foul air to a central gasholder, whence after purification it should be distributed for street lighting. Another proposal, about the same date, was that sewers should be hermetically closed, except at one

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point where an air pump would extract the foul air and drive it through fire or a solution of chloride of lime. A suggestion was also made that coke factories should be established near the lines of sewers, and the gases therefrom passed through the ovens.

1854. Sir Joseph Bazalgette, in London, successfully ventilated a sewer on the south side of the Thames, by carrying pipes from the crown of the sewer into the tall chimneys of two factories. In another case, however, in Friar Street, where this was again attempted, an explosion occurred which led to the abandonment of experiments in this direction for a time. Mr. Gurney, in the same year, tried the effect of steam jets introduced into a sewer, but without any good result.

1855. Mr. Mumby proposed that the gas lamp posts or columns at the sides of the streets should be used as sewer ventilators, but as these are only lighted at night Mr. Robins suggested that the posts should have trays filled with disinfectants placed in them over which the sewer air should pass.

1856. Shafts were erected at the ends of streets connected with the dead ends of sewers, and carried up the gable ends of houses.

Furnaces in connection with these shafts were also recommended.

1858. Mr. John Chisholm tried the effect of electrical or galvanic action upon the air in sewers, but without beneficial result.

1866. Trays filled with charcoal were introduced by Sir Joseph Bazalgette and others into the ventilating shafts.

1870. Sir Joseph Bazalgette successfully neutralized the foul emanations from a sewer by the introduction of trays filled with sulphurous acids.

1872. Screens or flaps were placed in sewers to regulate the currents of air in them. Messrs. Johnson and Hill proposed that ventilation should be effected by connecting all the house drains with the chimney flues. Mr. Miller suggested that the smoke from chimneys should be drawn into the sewers for the purpose of purifying the bad air in them, and at the same time of settling the London fog question satisfactorily.

1873. General Scott introduced lime into a main sewer, with the result, to use his own words, that "the main sewer was perfectly freed from stinking sewer gases."

Dr. Keates devised an apparatus for subjecting the foul air to the action of chlorine gas.

1875. Mr. Parker, the surveyor of Poplar, England, patented a method by which air was to be forced into the sewer by the action of the wind impinging upon a cowl.

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Sir Joseph Bazalgette erected a ventilating chimney, sixty feet in height, with a furnace burning coke, when, to use his words, "It was found that about 1 per cent. of the sulphur was given off by the coke, and acted as an efficient disinfectant."

Mr. E. Rumbold originated a method for passing the foul air through a spray of water introduced on all sides of the ventilating shaft.

In the same year, being struck by the absence of smell in an old sewer, in which quantities of stagnant sewage were giving off gases of decomposition, I came to the conclusion that this absence of smell arose from defects in the crown of the sewer, which allowed the foul air to be absorbed in the earth which covered the sewer. The outcome of this observation was the invention by me of what I have designated "The Sewer-gas Annihilator," the principle of which is based upon the well-known fact that earth has a powerful action in absorbing and deodorising any noxious gases or emanations arising from matters undergoing decomposition.

In 1882 Mr. Read, the surveyor of Gloucester, suggested that all house drains should be used as up-cast shafts to ventilate the main sewers, for he argued that as the sewer was used for the benefit of owners of house property, so should they contribute to the ventilation.

Mr. Harrington, the Mayor of Ryde, Isle of Wight, proposed in the same year a system by which air should be forced into the sewers by shafts furnished with cowls, his system being somewhat similar to that proposed by Mr. Parker in 1875, and already described.

1883. Mr. Rowan suggested the sub-division of the sewers into sections, so as to ensure their thorough ventilation, "each exhauster drawing from the inlets on either side of it, and the inlets consequently delivering air to the sewer in both directions." The abstractor to be of special construction, and to perform a double function—abstract the sewer air, and burn and destroy any organic matters or germs contained in it, the sewer air being made to pass through a number of small tubes heated by a gas jet. Mr. Rowan claims that not only is heat thus made to destroy the danger in sewers, but that fresh air is also admitted into them—the two most important points in connection with this question.

No reference has purposely been made to the almost numberless exhaust cowls that have been from time to time introduced, for experience and experiment have shown that their effect has not warranted their adoption. Mr. Ellice Clark, of Hove, has made several experiments in this direction, and in a report which he published in January of last year upon the benefit to be

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derived from what are known as Banner's cowls, he says "a greater velocity of air is obtained when the shafts have open terminations than when Banner's cowls are fixed upon the shafts."

With regard to the systems of ventilation at present in vogue, that of open gratings in the centre of the streets is the most general. By a return recently published, it is found that out of sixty-six important towns in England, fifty-five of them adopt this system, and it certainly has the merit of being economical and simple, both in construction and maintenance, and it relieves the sewer from any air-pressure when its contents are running at a higher level than usual.

The system, however, does not comply with sec. 19 of "The Public Health Act, 1875," which states that sewers shall be ventilated "so as not to be a nuisance or injurious to health." The street gratings are an undoubted nuisance, as they unload their foul air under the level of our noses, and it is possible they may be injurious to health, for although on being liberated the dangerous qualities of the sewer air are said to be diluted, dispersed, and rendered harmless and innocuous, it has never been satisfactorily proved that the atmosphere kills the disease germ should he be there lurking, or, if it does kill him, how long is taken in the process; certainly not the short time elapsing on the journey between the grating and the footpath. There is no doubt that excessive dilution lessens the risk of contagion, but the system does not seem successful unless immunity from nuisance and disease can be assured.

It is said that where the sewers are in a good condition no nuisance arises from the ventilators; if this is so, the question may fairly be asked if they are of any use in such cases, and whether the perfect sewer is not just as perfect without them. Advocates of the system state that it is impossible to have too many openings, and thus open sewers would, no doubt, be the most desirable. The town of Leeds is frequently held up as a model in respect of the ventilation of its sewers; let us compare its death rate with that of the town of Bristol, where not a single sewer ventilator exists:—

Leeds has a population of 15·2 per acre.
Bristol " " 64·5 "
Leeds had a death rate for 1883 of 23·30.
Bristol " " " 17·80.

Of this death rate those arising from the principal zymotic diseases were, as regards Leeds, 4·0 per thousand, as regards Bristol 1·1 per thousand.

The Commissioners of Sewers for the City of London have for a long time felt that the open gratings were not all that

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could be wished, and have consequently, quite recently, passed a resolution to enable their officers to treat with builders and owners of property for the purpose of erecting shafts, either in the walls of, or against new and existing buildings.

Open shafts carried up to safe heights certainly have many advantages over the foul smelling gratings in the centres of the streets; and the fashionable watering place, Scarborough, has, I believe, the whole of its sewers ventilated in this manner, there are, however, some objections to this system, which may be summarised as follows:—

The want of fresh-air inlets, the expense, and the difficulty in obtaining permission to erect the shafts just at the points where they are required, and of course, in new streets that are being sewered, and other localities, there are no houses against which they can be fixed.

The fresh-air inlets, as by Mr. Parker's and Mr. Harrington's systems, are an improvement, but they involve that great bugbear to the ratepayer, extra cost; and there would no doubt be some objections raised to obstructions of the kind being placed against the sides of the streets; otherwise these systems have much to recommend them.

The use of the rain-water pipes for sewer ventilation has often been justly condemned; they not only cease to act as outlets during rain, but also carry more air into the sewer; and, from their position and possibly bad jointing, are sanitarily dangerous. The town of Carlisle, however, ventilates its sewers in this manner, there being upwards of 2,150 rain-water pipes in direct communication with the sewers.

Charcoal trays are too well known to require any comment.

Large hollow lamp-columns have many recommendations, but they cannot be extensively used, and unless the gas is constantly kept burning they are of but little use.

Pipes carried from the sewer into neighbouring chimney shafts or under furnace fire bars is a practice that is gradually extending and has much to recommend it; it is well known that the most potent destroyer of all forms of germinal life or organic matter at all stages of their development is heat, and it is probable that in this direction scientific purification of sewers will be eventually attempted. At Leicester there are upwards of thirty chimney connections which answer satisfactorily.

The early dangers encountered by explosions in connection with this system seem to have been entirely accidental, and probably arose from the admittance of coal gas into the sewers from defective mains, and no recurrence seems to have taken place for many years.

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With regard to special lofty shafts fitted with furnaces, these seem to be effectual under certain conditions, as, for instance, upon main intercepting or outfall sewers where there are few openings, as in the case of Brighton, where a large shaft of this description has been in successful operation for some years; but Sir Joseph Bazalgette proved several years ago, and subsequent experiments have confirmed his opinion, that the effect of such shafts upon the general system of sewers would be very ineffectual, as the tendency of the exhaust produced by such a furnace is only to draw in sufficient air to feed it from the nearest opening.

In conclusion, I wish to lay the following points before you, in order that they may be discussed.

Is the present system of open sewer ventilation in the centres of the streets satisfactory? Does it comply with the requirements of the Public Health Act, 1875?

Do any of the systems which have been enumerated fulfil these conditions?

If the drains of all buildings are properly and efficiently trapped, ventilated, and the buildings thus isolated from the sewer, is any ventilation beyond a few relief pressure shafts necessary?

Should not this isolation of the house be made legally compulsory?

Mr. Dodson said he must at the outset declare himself one of the opposition in dealing with this paper. It would be, he thought, going back to the system of twenty years ago. He believed that there should be from end to end a thorough ventilation of the sewers. In London, Liverpool, and large cities, it would be advisable that great lengths of sewers should be divided into sections. In his opinion the ventilation of sewers would not be complete until it was carried out upon the principle adopted in coal mines.

Mr. Rogers Field, M.Inst.C.E., quite agreed with Mr. Boulnois as to the great importance, from a sanitary point of view, of having the houses isolated from the public sewer by means of an efficient system of "disconnection"; but could not agree with his proposition that the ventilation of the sewers should be omitted. Mr. Field used the word "omitted" advisedly, as he considered that the few small pipes which Mr. Boulnois proposed to have for relieving the pressure in the sewers would have such a slight effect that the ventilation might be practically said to be omitted. Mr. Boulnois' proposition was based on the assumption that every house drain in the town was efficiently "disconnected" from the sewer, but in practice this assumption would never be true. Even in the case of new houses it would be very difficult always to ensure perfect disconnection, and in

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the case of old houses it would be quite impracticable to do so. The only way in which such disconnection could be secured would be by a thorough house to house inspection, and by opening up the drains wherever necessary. Leaving out of consideration the difficulty about legal powers, he was not aware of any town in the kingdom which possessed a sufficient staff of competent sanitary officers to undertake such a task. If all the houses were not efficiently isolated from the sewer then the omission of the ventilation of the sewers would be very dangerous.

Mr. Stirling, C.E. (Dublin), was of opinion that if the plan suggested were adopted all the noxious gases in the sewers would be liable to be sucked into the houses by the heat of the fires and kitchen ranges. In Dublin it is inevitable that most of the house drains shall pass under the houses; here also, in most instances, there are sunk basements, with narrow sunk areas, towards or beneath the pathways; most commonly the drains cross beneath the kitchens, the walls have either no anti-damp course or none that is perfect, there is no impervious underfloor of concrete; these, he should think, were conditions common to many, if not most, towns of importance. It has been suggested that the joints of the house drains and sewer pipes should be left open for about four inches wide at the top, with lumps of broken stone over such open joints to collect the subsoil soakage water; this has much to commend it, especially in clayey and other retentive soils such as that in Dublin; isolation as against ventilation is not to be recommended for adoption with these conditions.

Mr. D. Emptage (Margate) was of opinion that the best way to ventilate the sewers was by means of shafts carried from the sewer side of the drain traps to the top of each house; by this means, owing to the number of shafts employed, air would be drawn in at the road gratings and discharged at a point high above all breathing places, the constant currents causing this outgo to be comparatively harmless. The great difficulty would be to procure the consent of house owners to these shafts being fixed; but he felt sure that this system, if carefully carried out, would remove the evils now so often experienced.

Mr. J. Wallace Peggs, Assoc.M.Inst.C.E. (London), thought that the paper would be valuable as indicating what had already been done in the question of ventilation of sewers. As mention had been made during this discussion of utilizing rain-water pipes for the purpose of ventilating public sewers, he thought that at a meeting of this kind it would be well to condemn in the strongest manner any such use of rain-water pipes. It must be obvious to anyone that the danger of ventilating a public sewer by the rain-water pipes, which, as we all know, terminated in all kind of positions near windows, is very great. There is not very much difficulty in ventilating a system of new sewers carefully laid down upon the best modern principles and made

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self-cleansing. The difficulty of ventilation occurs in our older towns, where we have sewers of deposit acting as retorts for generating foul gases and where the weight of flow in the sewers varies at different times of the day. It is necessary to keep up a constant movement of fresh air in all parts of a system of sewers. The usual method of ventilating sewers is by openings at the surface of the road, and Sir Robert Rawlinson, our president, has laid it down in his valuable "Suggestions" that ventilation should be provided for in all sewers at frequent intervals, not greater than 100 yards apart. The true principle of ventilation for sewers and house drains is to have the foul air constantly replaced by the admission of fresh air. A sewer must always have a constant current of air passing through it. There must be no resting places for foul air in a properly constructed system of sewers. The question of sewer ventilation is intimately connected with the house drainage question, and I will endeavour to explain what I mean from a case occurring in my own practice. A town was sewered on the best modern principles, and the old house connections were made good to the new sewers. After a short time great complaints were made about the ventilating openings at the surface of the streets emitting foul smells. Upon careful examination it was found that the old overflows of cesspools had been joined up to the new sewers, and the foul matters from the cesspools overflowed into the sewer. The remedy was to search out and entirely remove all cesspools, and carry the house drains direct into the sewers, without any such resting places. The sewage from houses should be carried away direct to the sewers and away to the outfall within a short time; and if this is done there will be very little difficulty in dealing with the ventilation of sewers. As a rule the openings for the ventilation of sewers and drains are much too small, and there are not sufficient of them. The value of ample ventilating space along a public sewer recently came under my notice, where I was called in to examine into the cause of bad smells along the public road, emanating from the sewer. For the purposes of examination I had several holes of large size made along the course of the sewers and at frequent intervals. The foul air coming from these openings when first opened was very offensive, but after the first day no nuisance was experienced at all, although in this case the sewer was laid very flat and the velocity of the flow of sewage was not much.

Dr. Alfred Carpenter (Croydon) related an instance which had come under his personal observation, in which catarrh had been caused by emanations from an opening in a sewer, for it happened to himself. He recommended a thorough ventilation of sewers, and the placing of intercepting traps between the houses and the sewers in all cases in which it was found impossible to make the local authority do their duty by providing sewers which should not be sewers of deposit, and which would not then contain anything that could ferment and give out the result of sewage decomposition. He intended publishing a history of the case in which catarrh had been caused by the emana-

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tions from a sewer. The circumstances were very peculiar, and he believed that the subject was one which should be fully investigated.

Sir ROBERT RAWLINSON, C.B. (President of the Congress), said that great care should be taken that the putrid matter and excreta from houses should be made to pass away instantly. Noxious gases should be liberated from the sewers, and not allowed to remain and endanger the health of the inhabitants of the houses by entering them. The subject of the ventilation of sewers was one of vast importance, as in many cases where typhoid fever was found to prevail in cities it might be directly traced to this cause. He recommended that the sewers should be carefully made, kept perfectly clean, and carefully ventilated.

Mr. BOULNOIS (Portsmouth), in reply, said that he had accomplished all he desired, in having by his paper led to such a large amount of instructive discussion upon this important subject. The whole point of his paper was the effective isolation of the dwelling house from the public sewer, and of course if this could not be effected his arguments fell through. He complained of the limited number of inspectors who were appointed under the different corporations. He was of opinion that they were entirely too few to be able to accomplish, in anything like a thorough or satisfactory manner, the proper supervision of house drainage, or the rest of the work required of them.

On "The Necessity for Efficient Ventilation of Sewers," by JOHN COLLINS, F.C.S., F.G.S.

IT is not difficult to realise how readily the public mind lends itself no less to an unlimited sense of security than to a gross and unreasoning panic; and it has been so exercised in both ways on this subject during a very recent period.

It has seemed to the writer, who has for some years been studying the subject, an opportune moment, when zymotic disease again threatens us so directly, to direct attention to the subject of this paper.

When we are assured that adequate ventilation is necessary to health, and that it is so for the purpose of effecting changes in the atmosphere we breathe—of removing effete and noxious matters no less than for the supply of fresh air and its contained oxygen—we might be expected to pay more attention to

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the subject than is commonly found to be the case. It is no less evidently true that a constant and sufficient supply of fresh air and a removal of waste matters is as essential to our comfort as to our health.

All organic matter is subject to change, and to what is commonly called decay or putrefaction. This putrefactive process may destroy living organisms, and so destroy the germs of disease. But it is also true that, under certain conditions, it may actually produce other germs.

In ordinary putrefaction of organic matters the azotized compounds are decomposed with evolution of nitrogen, giving rise to nitrates and nitrites, as the supply of oxygen is plentiful or otherwise. The carbon is oxidised, forming carbonic dioxide, while considerable quantities of sulphuretted hydrogen and of carburetted hydrogen are evolved.

Our modern system of sewers is intended effectually to collect and carry away alike from dwelling and workshop all that is used up, decaying, noxious, or even hurtful and dangerous. Hence we may assume for sewage that it will contain all these matters in a solid, liquid or gaseous form.

The organic matters therein are all more or less putrefactive, and constantly give off large volumes of the gaseous products of putrefaction.

These "sewer gases," as they have been termed, are ever present in greater or less quantity, and I am desirous in this paper to direct your attention to them, and to the absolute necessity for providing for them and for dealing with them.

They certainly seem to produce greater evils, more sickness, than would at first sight appear; and it is a well-observed fact that more sewer gas is evolved from liquid sewage than, under similar circumstances, from an equal amount of solid excrementitious matter. It is further ascertained that water assists most rapidly the growth of most organisms.

These gases are most noxious—they contain a "stinking vapor" which is in the highest degree offensive, and which inhaled produces headache, giddiness, and nausea.

Certain fevers have been directly traced to them. They always include that poisonous product of decomposition, sulphuretted hydrogen.

Several samples of liquid sewage have been examined, and are found to give, of gases in solution 36 to 75 cubic inches per imperial gallon. Of these

Carbon dioxide ...	... =	34 ...	70 °/₀
Sulphuretted hydrogen...	=	0·9 ...	3·5 „
Ammonia ...	... =	0·003 ...	0·0048 „
Marsh gas, &c. ...	...	Not determined.	

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On fermentation setting in the sewage is decomposed, and we get liberated gases, shewing—

Carbon dioxide	17·4 %
Carburetted hydrogen	70·9 „
Nitrogen	10·07 „
Sulphuretted hydrogen	2·3 „
Ammonia	0·0046 „

It is obvious that these gases must, by some means or other, obtain egress from the sewers, and they will effect this in face of the greatest obstacles. They find the smallest vent; they dissolve in water, to be liberated under other conditions; they percolate through the earth; they rise through "sink" pipes and rain-water butt overflow pipes as surely as they are formed day by day;—this, of course, in default of our providing an outlet for them where we may get rid of them with the minimum of evil consequences.

It is a fallacy of the most dangerous kind to say that sewer gases are no longer hurtful when they are no longer offensive to the sense of smell, for there is no necessary connection between bad odours and zymotic poisons. There may have been oxygen enough available to prevent disease, while there may not have been sufficient to prevent smells which nauseate and cause sickness.

The pestiferous matters which float over the African coast, the Indian Sunderbund, the Algerian plain, the Pontine marsh, and the English fen is not offensive to the nose though deadly enough to the body. And there are many horrible stinks that have no power to produce any disease.

It must be remembered that these gases are effluent at normal temperatures, and it will readily be seen how the increased heats of summer assist their increased evolution.

It is most difficult to say what is their condition and what the amount of their dilution which may cause sickness; but of this much we are certain, that a free admixture of air will kill all the germs of putrefaction and of disease; or if it does not kill, it so weakens them as that they are harmless.

Does not this fact alone teach the absolute need of effecting all that is possible in the immediate æration of sewage by plentiful ventilation and every other available means?

One danger, which has only of recent years faced the dwellers in our large manufacturing towns, is found in the closed cellar dwellings. These dwellings were compulsorily closed by the sanitary authorities of the day. They were closed arbitrarily and summarily. No compensation was offered or paid for loss of rental. They were found in the lowest districts, and many

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of them were closed ere it was incumbent on the owner or occupier to trap the sewers therein. Thus it happens that the old sewers of many of these disused dwellings are still open.

The timber and the glass of door and window have long given way in most cases to rough bricks and to still rougher boarding of the cheapest kind. The only "through draught" or ventilation which is possible is by the more highly heated and more open room above, through and by the accidental chinks and crevices in the floor of this occupied room.

The power for evil of these gases is here surely enhanced, for the damp and semi-fœtid atmosphere of the disused cellar is saturated with the sewer gas and its contained germs. That this is no imaginary evil is shown by the fact that in over 68 per cent. of these closed cellar dwellings the air from which has been examined, it was found so saturated with sewer gases.

That there should be found to exist an intimate connection between badly drained and ill-ventilated slums with their overcrowded, unwashed, underfed populations, and with an additional, though readily removable, danger like these "closed cellar dwellings" in their midst, and the constantly recurring outbreaks of epidemic disease is not surprising.

It is one of the objects of sanitary science to remove such blots on our civilization, and it must be to our satisfaction that we may feel we do something to this end by directing the force of public attention to them whenever they exist.

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TABLE I.—"SEWER GASES."

Gases dissolved in raw Sewage.

The results are stated in C.C. per Litre. Averages 100 samples.

	Carbonic Dioxide.	Carburetted Hydrogen.	Nitrogen.	Sulphuretted Hydrogen.	Oxygen.	Ammonia.
No. 1	2·69	5·01	16·2	0·60	1·21	0·004
„ 2	11·04	3·27	19·4	1·37	3·06	0·006
„ 3	7·32	1·56	15·8	4·02	2·51	0·006
„ 4	4·06	6·72	17·9	2·49	1·04	0·004
„ 5	17·49	2·04	20·6	3·06	3·23	0·004

The Laboratory,
Bolton-le-Moors, 22nd Aug., 1884.

JOHN COLLINS, F.C.S., &c.
WALTER HEPWORTH-COLLINS.

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TABLE II.—"ANALYSIS OF MEPHITIC VAPOURS"

From Disused and Unventilated Cellar Dwellings.

Results are stated in volumes per cent.

	Oxygen.	Carbon Dioxide.	Ammonia.	Ammonia Albumised.	Sulphuretted Hydrogen.	Nitrogen.	Marsh Gas.
No. 1	20·83	0·58	0·086	0·142	0·26		0·313
„ 2	20·85	0·64	0·088	0·139	1·02		0·206
„ 3	20·73	0·59	0·084	0·144	0·56		0·564
„ 4	20·71	0·49	0·087	0·153	0·64		0·606
„ 5	20·65	0·92	0·085	0·136	0·72		0·217
„ 6	20·62	0·95	0·084	0·146	1·13		0·393

WALTER HEPWORTH-COLLINS.

Bolton, 22nd Aug., 1884.

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On "Dublin Main Drainage Outfalls," by JOHN PURSER GRIFFITH, M.Inst.C.E.

IN discussing the question of the most advantageous position for the outfall of a main drainage system for Dublin, I think it may be assumed that main drainage is necessary, and that the objects of such a scheme are to purify the River Liffey and remove the sewage to such a distance that it shall no longer be a nuisance to Dublin or its suburbs.

That main drainage is a necessity has been admitted, firstly, by the action of the Corporation in promoting a Bill for the purpose, after having spent years in discussing every possible alternative; secondly, by the action of Parliament in sanctioning that Bill; and thirdly, by the recommendation of the late Royal Sanitary Commission for Dublin.

For the information of those not acquainted with the history of the Dublin Main Drainage Scheme of 1871, it may be desirable to describe briefly its principal features.

By the Dublin Main Drainage and Purification of the Liffey Act, the City Corporation were authorised to borrow £350,000 for constructing a system of high and low level intercepting sewers, terminating in a single outfall at the end of the North Bull Wall, at the north side of the entrance to Dublin Harbour.

The district to be drained consisted of the City of Dublin, and the townships of Pembroke, Rathmines, Kilmainham, and Clontarf, and the outfall sewer was designed to provide for the discharge of more than 7000 cubic feet per minute.

As the position of the proposed outfall affected the interests of the port, protective clauses were inserted in the Act, at the instance of the Dublin Port and Docks Board.

Two of these clauses deserve special attention. The first limits the time for the discharge of sewage from one hour after high water to one hour before low water, or during four hours of the ebb, and the second prohibits all solid matter or deposit from being discharged into the river, harbour, or bay.

Both these clauses are of vital importance to the port. Under no circumstances can those who are responsible for the maintenance of the navigable channel sanction works which may result in irreparable damage to the harbour entrance across the bar.

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In all such cases the onus of proof that works of the kind will not be injurious must rest with the promoters, and the Conservators of the Port are justified in insisting on every possible precaution being taken to prevent injury to the navigation.

Naturally such restrictions as those introduced into the Act of 1871 would add largely to the cost of the works. The limit of time for discharge necessitates large storage accommodation; and the removal of all solid matter requires costly appliances and heavy working expenses.

The main drainage works were tendered for in 1873, at a time when almost every material used in the construction of such works had risen to "enormous and exceptional prices," and the lowest tender received was over £775,000. As this far exceeded the borrowing powers authorised by Parliament, the plans were recast, with a view of reducing the cost. Early in 1874 tenders for the revised scheme were received, but the lowest tender was still in excess of the borrowing powers, and finally the scheme was abandoned on account of the financial difficulties involved.

The failure of the Dublin main drainage and purification of the Liffey scheme was shortly followed by the promotion of a separate drainage system for the townships of Rathmines and Pembroke. Both these districts had been included in the Dublin main drainage area.

Under the advice of Mr. Richard Hassard, the joint townships sought and obtained Parliamentary powers to construct an outfall for themselves at the White Bank, discharging into the Liffey about one mile inside the harbour entrance.

The plea upon which Parliament was asked to grant these powers was, firstly, the inaction of the Corporation; secondly, that legal proceedings were threatened for suffering the sewage of the townships to flow into the river Dodder; and, thirdly, that the townships had prepared, and were willing to undertake, an independent scheme, which would divert the sewage from the Dodder, and conduct it to an outfall removed from resident population, and leading directly to the sea.

The area of the joint townships is about 3,200 acres; their population in 1871 was 42,000, and the estimated quantity of sewage to be discharged 180,000 cubic feet in twelve hours.

In the Act authorising this scheme, as in the Act of 1871, the Port and Docks Board obtained clauses for the protection of the port. The most important of these refer to the limit of time for the discharge of sewage, the payment of an annual subsidy for any dredging necessitated by the discharge of sewage, and an indemnity of the Port Board from all responsibility for nuisance created by the outfall.

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The purification of the Liffey formed naturally one of the most important subjects brought before the late Royal Sanitary Commission, and it is a matter of the utmost importance to remember that the commissioners in their report clearly state, "We are of opinion that the River Liffey and the port and harbour of Dublin ought to be freed from pollution, and that the sewage of the entire city and its suburbs ought to be so disposed of as no longer to constitute a nuisance within the River Liffey and Harbour of Dublin."

Of the five schemes for the main drainage of Dublin laid before the Royal Commissioners, three were rejected because, using the words of the report, "though intended to purify the River Liffey, they did not provide for carrying the sewage out of the harbour, but proposed to discharge it within the limits of the port, and consequently would not purify the port and harbour."

I wish to lay particular emphasis on this opinion of the Royal Commissioners, as I firmly believe that any scheme carried out should fulfil these requirements.

When the Royal Commission sat in Dublin the Rathmines and Pembroke main drainage works were in course of construction, and it was considered by the Commissioners that the drainage of these townships might be excluded from any scheme dealing with the drainage area of Dublin.

We have now, however, had several years' experience of the actual working of the Rathmines and Pembroke main drainage system, and the results prove the truth of the predictions that this scheme would result in the pollution of the lower reach of the river Liffey, and that a great proportion of the sewage would never get out to sea, but be carried by the flood-tide on to Clontarf strand.

The experience of the past summer seems to me to put this beyond the region of doubt, and so thoroughly impressed am I of the injurious character of the pollution caused by this outfall, that I believe no scheme will satisfy the conditions laid down by the Royal Commissioners unless it deals with the drainage of Rathmines and Pembroke, and intercepts the sewage at present discharged at the White Bank outfall, and thus frees the river and harbour of Dublin from pollution.

The main drainage scheme approved by the Royal Commissioners was that of Mr. Neville, the city engineer, whose thorough knowledge of the drainage of the city gives his opinion great weight, especially as regards the construction of high and low level intercepting sewers through the city.

His proposal, as laid before the Commission, was the same as that of 1871, with, however, some modifications, chiefly due to the construction of the Rathmines and Pembroke works. The

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capacity of the sewers was reduced, and the omission of the large storage reservoirs on the North Bull appeared to be contemplated. As the Port clauses of 1871, relating to the period of discharge, and the total removal of solid matter out of the sewage before its discharge at this outfall, must be introduced into any Act authorizing this scheme, I am at a loss to understand how the storage reservoirs can be omitted, and the saving of £50,000 referred to in Mr. Nevill's evidence effected. The proposal seems based on the idea of a similarity between the Rathmines and Pembroke outfall and that at the end of the North Bull wall. The cases are totally different, for at the White Bank any deposit from the outfall can readily be dealt with by dredging, while at the North Bull outfall no dredging could be done, and therefore the Port Board could accept no money subsidy as compensation for such deposit.

There can be no doubt that but a small portion of the sewage discharged from the Rathmines and Pembroke outfall finds its way out of the harbour, and consequently that any deposit from the outfall will be found in the river channel or on the banks. If in the river channel it can be dredged, while if it deposits on the adjoining strands it becomes a nuisance to the neighbourhood, but not an obstruction to navigation.

Both these contingencies are provided for by the Port clauses in the Rathmines and Pembroke Main Drainage Act. The first by a payment of about £250 a-year for dredging, and the second by a saving clause indemnifying the Port Board from all responsibility for nuisance created by the drainage works. The North Bull Wall outlet differs entirely from that at the White Bank in this respect, that for no money consideration could the Port and Docks Board undertake the responsibility of permitting any discharge which might create deposit in the neighbourhood of the bar.

Now, from our present knowledge, it seems certain that a large proportion of the sewage discharged from the North Bull outfall will not go beyond the bar, that during neap tides it will return into the harbour and flow up on Clontarf Strand, converting this Strand into a pestilential slob of about 1,600 acres in extent. We can scarcely imagine what this means. Possibly if we remember that the area of the bed of the Liffey uncovered at low water, west of O'Connell Bridge, which is now so much complained of, is but the two-hundreth part of the area of Clontarf Strand, an idea may be formed of what this nuisance will become in hot summer weather, with a light wind blowing in from the sea. In time it would simply become intolerable to the township of Clontarf, and, sooner or later, the outfall would have to be abandoned for a more distant one at Howth.

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A Howth outfall has been talked of ever since Dublin main drainage has been seriously discussed, but Mr. Hassard has the credit of laying the details of a specific scheme with an outfall at the Nose of Howth before the Royal Commissioners.

While disagreeing with him as to the position of the outfall, which I should prefer to be either at the Bailey or Drumleck Point, I think the principle of his scheme correct, namely, to pump the whole of the sewage, and to have a constant discharge at the outfall, thereby requiring no storage.

Mr. Hassard's proposal for the city drainage forms a striking commentary on his Rathmines and Pembroke scheme. Surely if the White Bank outfall fulfilled the conditions of a good main drainage outfall, it would have answered for the city also. The mere fact of having to pay the Port Board an annual subsidy, even equal to ten times that paid by the townships, would not be a sufficient reason for incurring the additional outlay required to carry the sewage to Howth, and the annual expenditure for pumping, amounting to more than £3,000 per annum.

I do, however, believe that the removal of the outfall to Drumleck Point on Howth is fully warranted, as, although the interests of navigation can be protected by stringent clauses, such as have been inserted in the Acts of Parliament referred to, nothing short of this distant outfall will preserve the strands within the harbour of Dublin from sewage pollution.

My object will be attained, if by freely expressing my own views, based on an intimate knowledge of the port and harbour of Dublin, those into whose hands the main drainage of Dublin may be entrusted are led to reconsider carefully the position of its outfall.

The main drainage of Dublin and its suburbs is a work of so much difficulty and magnitude that I believe it can only be done by the joint action of the city and surrounding districts. I would therefore suggest the formation of a main drainage board for the whole drainage district surrounding Dublin Bay, including Dalkey, Kingstown, Monkstown, Blackrock, Pembroke, Rathmines, Kilmainham, Drumcondra, Clontarf and the city of Dublin, not necessarily with the object of discharging the sewage from all these districts by one northern outfall, but to ensure the proper drainage of each of these districts, and protect them from damage by the discharge of sewage from their neighbours' outfalls. As matters at present stand several of the townships cannot separately construct outfall works without injury to their neighbours.

The results of the Rathmines and Pembroke Main Drainage Works should be accepted as a warning against further isolated

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action. A very large sum has been spent on these works, which I am convinced must sooner or later be abandoned if the strands within the harbour of Dublin are to be freed from pollution. Combined action has already been successfully carried out in the case of the reconstruction of O'Connell Bridge and the building of the Swivel or Butt Bridge. The cost was defrayed by what is known as the Bridge Area, a district specially formed by Act of Parliament, extending far beyond the limits of the City, and surely the purification of the Liffey and Harbour is even a work of greater importance to the districts surrounding the city of Dublin.

In conclusion, I would briefly summarize the foregoing remarks.

1. That it is necessary to free the River Liffey and Harbour of Dublin from sewage pollution.

2. That to carry this into effect, any main drainage scheme must intercept the sewage of the townships of Pembroke and Rathmines, as otherwise the Harbour of Dublin will still be polluted.

3. That in the interests of navigation, the proposed North Bull outfall will necessitate large storage accommodation and costly appliances for removing all solid matter from the sewage.

4. That the sewage will be brought back in large quantities on to Clontarf Strand during neap tides, thereby defeating one of the objects of the scheme, and causing an intolerable nuisance in the neighbourhood of Clontarf which must sooner or later be removed.

5. That the great cost of the works on the North Bull Wall, and the storage accommodation necessary, would go a long way towards constructing an outfall sewer to Drumleck Point, at Howth, through which a constant discharge could be maintained.

6. That to ensure successful results, the whole drainage district of the Bay of Dublin should be dealt with by a joint main drainage board.

Sir Robert Rawlinson, C.B. (President of the Congress), observed that Mr. Griffith was a representative of the Port and Docks Board, and might accordingly take a view quite different from persons examining the question solely from a public point of view.

Mr. Parke Neville (City Engineer, Dublin) spoke in support of his own scheme for bringing the discharge to the end of the North Bull Wall. Ample experiments had, he said, shown that the set of the tides would carry the discharged sewage away from the bar

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without leaving any deposit on Clontarf strand or the bar. If Dublin were to be obstructed by the Port and Docks Board, a very long period would elapse before a system of main drainage could be executed. At the present time the sewage flowed down the harbour towards the bar. An outfall commencing so far down the harbour as the end of the North Bull Wall must be less injurious to the bar.

Mr. Patrick Doyle (Kingstown) remarked, with regard to the effect of the proposed scheme on Kingstown, that he was of opinion the harbour or surroundings would be in no way injuriously affected. For the sewage of Kingstown, to which Black Rock was now added, it was arranged to have an outfall near the end of the west pier of Kingstown harbour, discharging into thirty feet of water at low tide, and the current from the North Bull impinged against this point, and carried all away into the strong set of tide to the Mugglins, and this being so, he did not see of what use the drainage board, as proposed by Mr. Griffith, would be to Kingstown. They did not want it. To prevent the pollution of the River Liffey was a matter of great importance and interest. Any well-devised scheme to effect it was most desirable. He considered that the River Dodder, polluted as it was from its source, draining a large basin with a considerable population, and discharging into the Liffey at Halping Pool, tended immensely to add to the existing complained-of state of affairs, lodging all its filth and abomination on the foreshores up to the Pigeon House and on Irishtown Slobs. He believed the course of the Dodder could, with great advantage, be changed, and turned out on the Strand at Irishtown, and that thus a southern discharge for Dublin could be easily arranged, constructing a reservoir or reservoirs in the sandhills near the Poobeg, discharging all sewage matter at ebb tides, the current here setting strong for the west pier, Kingstown, and thence to the channel between the Mugglins and Dalkey Island. No doubt the abstraction of some scouring power from the Liffey might be advanced as an argument against this arrangement, but as the sewage would be delivered outside the bar, the loss was thus compensated for; also changing the course of the Dodder, as suggested, would reclaim a large tract of Slobs, thus far recouping this outlay. Any fear of the adjoining foreshores being polluted could, without difficulty or expense, be avoided. He considered, that on the lines above suggested, a southern discharge for Dublin sewage was desirable, which he was not aware had as yet been brought under notice and considered.

Mr. L. L. Macassey (Belfast Water Works) observed that he had given some attention to the subject of sewage outfall in Belfast, where things were nearly as bad as in Dublin; in fact both those cities were in a very similar position as regards outfall. They had to depend on the sea for taking away the town sewage. In questions of this kind the harbour interests were generally set up as hostile to those of the general community. Schemes for sewage outfall were often blocked because a little more annual dredging might be thrown on the harbour authorities. This was too narrow a view to take when the

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health of a large population was concerned. It would be much wiser policy were the town and harbour boards to pull together instead of acting in opposition, as is so frequently seen now-a-days when questions of this kind are under discussion. Mr. Griffith had spoken in rather an unfavourable way of the scheme proposed by the city engineer for the disposal of the Dublin sewage. He apprehended that the sewage matter would be lodged on the Clontarf Sands, instead of being carried out to sea. Mr. Macassey had not sufficient information to enable him to go fully into the question raised by Mr. Griffith. This gentleman had given the meeting his conclusions, but had submitted no details or data to enable the members of the Congress to judge whether his conclusions were sound or otherwise. Mr. Griffith's views might be correct, but he had certainly failed to support them by any evidence. The city engineer had told the meeting that he had tested the currents near the proposed outfall at the North Bull, and the outcome of all the experiments made was clearly in support of the position selected for the outfall works. The city engineer had also given them full details on other matters connected with the scheme. This was intelligible to the Congress, and, on the data supplied it was possible to form some opinion. Mr. Macassey did not wish to be understood as advocating the scheme proposed by the city engineer as the best that could be adopted for Dublin. He had too little data in his possession to speak decidedly on this point, but he felt bound to say that in his opinion Mr. Griffith had entirely failed to prove that the city engineer's scheme was defective in the matter of outfall; in fact, Mr. Griffith's paper, if it had any positive tendency at all, went rather to support the views put before the meeting by the city engineer.

Prof. F. de Chaumont, F.R.S. (Southampton), one of the commissioners for inquiring into the condition of the Thames, unhesitatingly declared, in reply to Sir R. Rawlinson, that the discharge of crude sewage into a river should not be permitted under any circumstances. There could be no doubt that if a point could be found sufficiently distant from human habitations for discharging sewage into the sea that would be a safe way of dealing with it. But careful inquiry and experiments should be made to ascertain if the currents would return any of the discharged matter. The primary question for a sanitary authority ought to be the getting rid of sewage as a public nuisance; and the question of making money out it, which was too often made the primary object, ought to be regarded as very secondary. During one of their trips upon the Thames last summer to ascertain for themselves the state of the river, four out of the party of six (viz., three commissioners and the clerk) were seized with violent diarrhœa in consequence of the abominable stench, and if cholera had been prevalent at the time in London, the effects might have been much more serious.

Sir Robert Rawlinson, C.B. (President of the Congress), said the sewage tanks in London were originally constructed to equalise the

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flow of sewage in the twenty-four hours, and it was laid down that under no conditions should the flow from the tanks take place until two hours after ebb tide had commenced, and thereby the volume of sewage collected during the preceding twelve hours would pass away to sea and not return. Either these tanks were too small, or the population had outgrown their capacity, because it was now found they did not answer their original purpose. A recent inquiry was held to ascertain whether sanction should be given to the Metropolitan Board expending £160,000 to acquire increased tank accomodation. Strong opposition was offered by the Conservators, and an appeal was made to the Home Secretary, which resulted in the appointment of the Royal Commission, of which Prof. de Chaumont was a member. Tanking was not a purification of sewage. He did not know that the Thames would be at all benefitted even if the tanks fulfilled their original purpose. Tanking sewage made it semi-putrid and capable of doing greater injury than if it were carried away immediately. Tanks would become more and more unnecessary, as that remnant of barbarism—macadam, disappeared from the streets. Macadam streets were simply a rude sort of mill for grinding stones into dust in summer, and into mud in winter.

Mr. J. P. Griffith (Dublin) in his reply, said it was suggested that he had viewed this subject solely in the interests of the Port of Dublin, regardless of those of the City. He, however, considered that the interests of the Port and City could not really be separated. In discussing the subject he had endeavoured to avoid taking a prejudiced view. His connection with the Port naturally gave him special opportunities for forming an opinion on this question, and he expressed his opinions in no captious spirit, but with the hope that they might induce those responsible for the execution of the main drainage of Dublin to investigate the problem afresh, so as to ensure that no scheme would be adopted without an adequate knowledge of the tides and currents of the bay.

With certain restrictions as to the discharge of sewage from the North Bull outfall the safety of the Port might be ensured, but he believed that if this outfall were adopted the Harbour of Dublin would not be freed from pollution. Mr. Neville had referred to certain float experiments in which the floats had invariably gone out in the direction of the Bailey, thereby proving that the sewage discharged from this outfall would be carried out to sea. That in itself indicated that these experiments were too limited. If float experiments were to be relied on, and he knew of no better evidence as to the direction in which sewage would be carried by a current, such experiments must be made systematically at all hours through neap tides as well as springs, and floats started from the proposed outfall must be traced not only on the ebb tide but through the following flood tide. Such a set of experiments, although involving a large expenditure of time and money, would be of immense advantage in the interests of the City of Dublin.

These experiments would, he believed, prove that a large proportion

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of the sewage discharged from the North Bull outfall would be carried towards Kingstown by the ebb tide, and return into the harbour by the flood tide, and be carried upon Clontarf Strand.

The experience gained by the London Main Drainage Works should not be lost sight of. The result of not having carried the outfall sufficiently far from London was now evident from the polluted condition of the Thames, and costly works were in contemplation to remedy this defect.

If the North Bull outfall proved a failure no extension of it would be possible, and the only remedy would then be to abandon the costly works constructed along the North Bull Wall and carry the outfall to Howth. The necessity for reservoirs had been challenged on the ground that those in London had not been successful. The evidence given before the Royal Commission on the Metropolitan sewage by Sir Joseph Bazalgette, showed that the reason of their want of success was insufficient capacity, and that the Metropolitan Board of Works were prepared to expend £160,000 on their enlargement. No attempt was made in London to remove the solid matter before discharging the sewage into the Thames. This would however, in the case of the North Bull outfall, be essential in the interest of the Port of Dublin.

He wished to lay great emphasis on the advantages of a Main Drainage Board for the City and its suburbs, both on the north and south sides of the bay. The townships of Blackrock, Monkstown, Kingstown, and Dalkey, were at the present moment suffering from the evil effects of divided authority in the matter of main drainage. If some of the drainage schemes proposed for these districts were ever carried out, not only would the results be unsatisfactory to themselves but injurious to their neighbours, and probably prove a fruitful source of litigation.

Mr. Cotton had asked what the extra cost of the Drumleck outfall would be over that at the North Bull, and what advantages it had over that of Mr. Hassard.

The cost would not exceed the estimate for the North Bull outfall, including reservoirs, by more than £50,000.

The great objection to Mr. Hassard's proposed outfall was that it would be practically impossible to obtain permission to construct the outfall so close to the town and harbour of Howth and the most populated part of this seaside resort. Whereas no great opposition would be raised to Drumleck, and the discharge would be into the Rosley Channel, where the tide sets for nine hours to the eastward.

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On "House Drainage in Connection with Town Sewers," by George Benjamin Nichols, F.S.A., F.G.S., F.R.M.S.

In introducing the subject of house drainage connection on to the main sewers of a town, I think it will be admitted by everyone professionally connected with sanitary works, and others who take an interest in sanitary regulation, that this is a matter of the most vital importance, not only to the health of the individual inhabitant householders, but to the public at large.

I shall endeavour to bring the subject before you in as brief a manner as is possible, consistent with the various details connected with this branch of our sanitary regulations, and at the same time to lay before you some of my experience of recent date in connection with the sewerage of towns of large populations.

You will agree with me that the subject is of sufficient importance with regard to the proper construction of a perfect system of sewerage that any remarks or information that can be brought to bear on the matter is well worthy of our consideration at the present meeting of the Sanitary Congress, and I trust the introduction of the subject will lead to a discussion which may tend to the interest of the Sanitary Institute of Great Britain, of which I have the honour of being a member, and of those engaged in sanitary pursuits, and also to the welfare of the public.

We are fully aware of the large sums of money which have been expended in the construction of a system of sewerage for most of our large towns in England, and of the great care generally exercised by the town authorities to have the work well laid out and well constructed, and likewise we are aware of the care bestowed by the engineers of the Local Government Staff as inspectors who examine the various schemes brought under their notice and the value of their reports thereon, and how carefully these are considered by the chief of the engineering staff—I allude to our highly-esteemed and eminent friend Sir Robert Rawlinson.

It has been frequently observed how the skill of the engineer in laying out a scheme of sewerage is frustrated and his work condemned, not only during the progress of the work, but when it is completed, and proved to act in the most admirable manner for the use and benefit of the inhabitants, works on which a

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large expenditure has been added for the purpose of properly and perfectly facilitating the discharge of the drainage from the houses and premises on to the main sewers in order to preserve them from injury and to insure that they should properly perform the work allotted to them. And what do we find? That there the work as regards its sanitary functions ceases.

Now, it is upon this most important feature in a scheme of sewerage that I have ventured to request your attention, "and for this reason." In many cases, the engineer having completed his scheme and handed it over to the authority, in every respect satisfactory, is afterwards blamed, and his scheme condemned, because of the neglect of the authority in not providing and insisting on the work of the house connections being carried out in due time and proper progressive order; and what is still more to the point, with proper and suitable materials, necessarily required in accordance with what the scheme demands for its success, and sometimes necessitated under the peculiar circumstances of the locality.

In all cases the work should be done under the control and supervision of a thoroughly qualified person paid by the authority, in accordance with a reasonable code of Bye Laws, specially adapted to be suitable to the district and the requirements of the scheme, and regulated by a fair schedule of prices based upon the cost of material and labour.

It is, however, a pleasing thing to be able to record that as far as I have been able to ascertain, with very few exceptions, has the work of town sewage, when intrusted to a qualified engineer, been a failure as regards the main works of the sewers themselves. But it is a source of regret that we find, in too many instances, an authority having laid down, at a great expense, a scheme of sewerage most admirably adapted to their district, consider that they have done their duty and all that is required of them, and the important work of the house connections is left to be done by the owners of the property, just as they please, the result of which is, as we are all fully aware, one of the greatest hindrances to the success of the best laid out scheme of sewerage that can be imagined.

To go into the multifarious details with which we are, I regret to say, but too familiar, would be only taking up our valuable time. Town surveyors know too well, from their own personal experience, these various defects, and the humorous dodges (if I may make use of the expression), exercised by the lower classes of builders, whose only object is to get the work done anyhow, so that they can say the premises are thoroughly drained and connected on to the main sewer.

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With regard to my own experience of these matters I can only say, and I say it with great reluctance, that if the engineers of works or the duly appointed surveyor to a corporation, or an urban or rural sanitary board shows a disposition to insist on the work of the house drainage being properly connected on to the sewers, and with suitable materials adapted to the particular circumstances of the case, he more than often gets himself into trouble. The owners of property, as a rule, object to have their premises interfered with under any special rule, and they consider they know what ought to be done to their own property better than any one else can tell them, and that having to pay for the work they have a right to employ whom they like and get the work done as cheaply as possible, and any expostulation by the sanitary officers is at once complained of to members of the authority (who may or may not happen to be friends), which often leads on to a series of public meetings to condemn the action of the local authority on the grounds that if insisted upon it is interfering with the rights and privileges of the ratepayers.

I have maintained, and still maintain, that all schemes of sewerage should be designed and constructed to receive the house drainage in the most perfect manner, and that so soon as the sewers are ready to receive the sewage the owners of property should be compelled to carry out a perfect system of house drainage and connections to the sewer upon one principle, such principle to be maintained and supported by the authority and under their entire control, and any deviation therefrom should be subject to the highest penalties the legislature can enforce.

In two instances on some extensive works in England on which I have been engaged I adopted this principle, and I was supported by the chairman and a majority of the members of the authority. But the expense of having the work done in a proper manner and arranged to be carried out by the contractor for the main works, under a special schedule of prices included in his contract, led to complaints by some of the inhabitants, not on account of the manner in which the work was carried out (which, I may mention, was being carried out under the superintendence of the resident engineer in charge of the works), but on account of the cost. Some of the so-termed independent ratepayers condemning the action of the authority, simply on the grounds which I have referred to, and this arrangement was abandoned. Anyone was allowed to carry out the work in a manner after his own fashion, by the most ignorant of workmen, with the cheapest of materials. The junctions in the sewers were never looked for, and the sewers

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consequently got broken into, and damaged to such an extent that, in many instances, they became partially blocked.

We are all aware that the local Government Board recommend the advance of capital to carry on these sanitary works, and, in doing so, I am of opinion that they would do well to insist that the house drainage and connections should be made to form part of the whole scheme of sewerage, and hold the authority responsible for this work, which, in every instance, should be carried out under the supervision of thoroughly qualified officers. If such a state of things could be accomplished under some enactment, we should have our habitations in a healthy condition, and be free from the effects of sewer gas, and the mortality reduced to a state which would not only gladden the hearts of those for whom the work was performed but of the whole community.

[*For discussion on this paper see page* 302.]

On "*Domestic. Drainage in Dublin,*" *by* W. KAYE PARRY, M.A., Engineer to the Dublin Sanitary Association, Examiner in Sanitary Engineering, King and Queen's College of Physicians, Ireland.

So much has been written on the subject of drainage, during the last few years, that the topic has become somewhat threadbare; and when Sanitary Protection Associations are springing up in every town, it may reasonably be asked what features of special interest can be claimed in connection with the drainage of Dublin houses to warrant the intrusion of this paper into the limited time at the disposal of our section.

The object of the following remarks is two-fold—firstly, to show to the members of the Congress that the proper machinery exists in this city to enable the residents to ascertain, for a moderate fee, the sanitary condition of their dwellings, and to afford them disinterested advice and assistance in remedying defects; and, secondly, to suggest some of the practical difficulties which assail the engineer in his endeavour to improve the existing arrangements.

In the year 1883 the Dublin Sanitary Association, which had for some considerable period been engaged in promoting sanitary reform, resolved to add to its other important functions the

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duties connected with sanitary protection. The necessary rules were framed, a scale of fees was decided upon, and the writer was appointed Engineer to the Association and sent to Edinburgh to examine and report upon the working of the Sanitary Protection Association in that city. During the fourteen months which have elapsed since similar work has been undertaken here, some seventy inspections have been made, chiefly in Dublin County and City. This number, although far below what might reasonably have been anticipated, may be considered a fair inauguration, and each succeeding quarter shows a steady increase. Hitherto no attempt has been made to secure for the members the benefit of periodical inspections, but the committee is fully alive to the importance of this step and have it in contemplation.

It is hardly necessary to point out that the essential difference between the system of sanitary protection adopted by the association and others offered to the public is, that with the association there is nothing to be gained by putting the householder to unnecessary expense, as the fees both for the report and for the necessary supervision of any alterations that may be suggested, are fixed, and do not represent a percentage on the expenditure; and when members do not see their way to adopt all the recommendations, assistance is rendered to enable them to secure, at the least possible outlay, comparative immunity from risk.

Turning to the second object of this paper. Dublin, while in many respects it resembles other towns, presents some special features which demand exceptional treatment and entail corresponding difficulties.

Those who have read the Report of the Sanitary Commission which sat in Dublin in 1879 will understand that although much has been done to improve the condition of the main sewers, they cannot be said to be satisfactory; many of them are of an obsolete section and encourage the retention of sewage; others are tide-locked to such an extent as to interfere materially with their efficiency; while in other cases the position of the sewer is open to the gravest objection. As an instance of the last-named defect, it may be stated that in a leading street the main sewer runs parallel to, and partly beneath, the flank wall of one of the houses, and actually flows beneath the centre of the floor of the meat larder. The writer has seen the water of the Liffey bubbling up through the surface traps in the areas of the Four Courts, in spite of precautions which exist in the shape of a flap valve and a Penstock. Houses situated on the quays are periodically subjected to this tidal influence, which carries back the sewage and

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compresses the gas to such an extent that traps can hardly be expected to offer an effectual barrier to its entrance.

Another difficulty arises from the fact that, as in other old towns, the house-drains in Dublin were formerly constructed of brickwork or rubble, tiles and flags, and the sewers are consequently not provided with suitable junctions for the reception of the pipes which are replacing the old-fashioned built drains. The connection between the pipe and the sewer cannot, therefore, be regarded as satisfactory, and in many instances it is feared that through the carelessness of workmen the wall of the sewer is not securely built up round the pipe, and the subsoil, for this reason, may become saturated with sewage.

Another cause operates more powerfully in the last-named direction, and it is this: that the drain-pipes which are laid by the Corporation workmen beneath the roadway, between the house and the sewer, are not jointed either with cement or clay, and a considerable portion of the liquid which passes into them must of necessity escape into the ground.

In connection with the last remark it is instructive to note that when the Dublin Port and Docks Board were repairing one of the quay walls they came upon the gravel which underlies that portion of the city, and the air of the diving bell in which they were working became charged with sulphuretted hydrogen to such an extent as to become almost irrespirable. Whether the presence of this gas is to be attributed to sewage or to other causes I must leave to the chemists to determine.

The sub-soil drainage of city houses has hardly been dealt with satisfactorily. Since the introduction of the Vartry into Dublin the wells have fallen into disuse, and the level of the sub-soil water has risen. The old-built drains permitted this water to percolate into them through the interstices of the walls and covering flags, and carried it off to the sewers, but the would-be sanitarian steps in, with the salt-glazed socketted pipe with cemented joints, and makes no provision for the removal of this water; the consequence is, that the basements of many Dublin houses are found to be more damp than under the former conditions. No doubt the problem is beset with difficulties, because while on the one hand we must guard against sand or loam being carried along with the water into the pipe drains, if any connection is made with it, on the other hand precautions must be taken to prevent the sewer gas escaping at the connection, and polluting the ground air in the neighbourhood of the house.

In addition to the foregoing there are the difficulties which must be grappled with in every case where a reformation in house drainage is attempted. Foremost amongst these may be

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placed the intercepting trap between the house drain and the sewer. We are all familiar with the many forms of trap which have been designed for this purpose, but the problem can hardly be said to have been, as yet, satisfactorily solved. What is required is a trap which is not liable to choke, and which can be readily cleaned out, having an effectual water seal and yet holding as small a quantity of water as possible, which should be changed with every flush. What is found to exist in most cases is a running syphon, a man-hole syphon, or a Buchan buried underground in some unknown position, the existence of such a trap not being suspected until a stoppage occurs, and liquid sewage begins to well up through the surface gratings in the areas. If we are asked whether there is any interceptor which can be relied upon to do its duty without attention for a number of years with unimpaired efficiency, we must at present answer, "No!"

The second point of importance is the ventilation of the drain. Upon what are we to rely to set the air in motion, and what should be the direction of the current? The course which is usually adopted is to arrange the fresh air inlet near the intercepting-trap in the front of the house, and to carry up the soil-pipe full bore to the roof, to act as a foul air outlet, but there are some obvious objections to this device. In the first place, the area of the cross-section of the soil-pipe is seldom more than one-half that of the drain-pipe, and the passage of the air must be seriously impeded unless a powerful induced current can be set up; and, secondly, every flush of water sent through the pipe reverses the air current, the inlet becomes an outlet, and the olfactory nerves of sensitive people are unpleasantly excited. To meet this objection, the soil-pipe is sometimes arranged as the inlet, and a ventilating pipe carried up the front of the house to act as outlet; but again we encounter the difficulty of reverse currents, for there must be a considerable difference in level between the in-go and the out-go of the air-syphon to ensure a steady current. This necessitates keeping down the head of the soil-pipe, and if the pipe be exposed to the rays of the sun the current may even then be reversed, and sewer gas delivered at a dangerously low level. The only other alternative is to fix a ventilated soil-pipe intercepting-trap, such as that designed by Mr. Hellyer, at the foot of the soil-pipe, and provide independent drain ventilation. This generally means taking a pipe from the head of the drain to some point in the back garden, and running the risk of giving the children the benefit of whatever emanations the air may carry with it.

In many Dublin houses the ground floor water-closet is in a return building at the rear, and thus constitutes another difficulty.

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If both the soil-pipe from this closet and the one from upstairs are directly connected with the drain and only one air inlet provided, we may have all the foul air at times passing out through the soil-pipe at the return building, the head of which cannot be much higher than the roof of the return, which is generally below the level of the upper windows of the main building; a second ventilated trap on the main line of drain in the back area will give two independent circulations, but the multiplication of such traps is in itself a fertile source of future derangement.

Theoretically we all know that house drains should be laid in straight lines, with man-holes for inspection at every change of direction; but in remodelling the drains of old houses how difficult it is to observe this rule without planting man-holes in the floor of the house itself, and if that be done can we rely upon the joints of the covers being really air-tight? Nor must we forget in enumerating the difficulties to include the grease. If we provide one of the many traps now in the market to arrest the fatty matter and prevent its entering and choking the drain, how are we to ensure the periodical cleansing of this appliance? will it not be often neglected, until it is found to be literally crawling?

Chloride of lime, in the hands of a fussy matron, is a dangerous enemy to the drains. Some people introduce large quantities of it, periodically, into the pipes, and the intercepting traps often get choked in consequence. But a worse foe than the lime, in the hands of the mistress, is the size in the bucket of the house painter, who regularly pours it into the most convenient surface trap, and neither thinks of nor cares about the evils that may result.

There is nothing original in the foregoing statements; every sanitary engineer encounters similar problems in his attempts to reconcile theory and practice, but we have met to exchange ideas, and it is hoped that a discussion will arise upon some of the points alluded to, and that the result will be profitable to those who are interested in the subject.

[*For discussion on this paper see page* 302.]

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On "Practical Sanitary Lessons, derived from 1,000 *Sanitary Inspections of Dwelling Houses in Ireland," by* WILLIAM ROBERT MAGUIRE, F.R.Met.Soc.

WHILE it is customary and, indeed, quite natural to expect men of scientific and literary attainments to lecture and write on sanitary matters, practical sanitary workers are not often asked to state their opinions, and, being busy men, they cannot spend time in pressing them on the attention of the public. On some sanitary matters, however, they hold very decided opinions which, embodied in practical suggestions, may be serviceable to the public at large, and, therefore, worthy of the attention of a Congress of the Sanitary Institute of Great Britain. As the writer was the first practical sanitary worker to introduce and establish systematic sanitary inspections and insurance of dwelling houses in Ireland, he hopes for your indulgence while endeavouring to place before you some facts of practical sanitary moment, noted carefully during the labour involved in inspecting and reporting on the sanitary condition of over 1,000 houses in this country, a wide area of insanitary domestic existence, the extent of which can only be appreciated by those who have actually shared in similar work.

These sanitary inspections of dwelling-houses in Ireland, chiefly in Dublin, have abundantly confirmed the startling statement, first made boldly and publicly with authority by the President of this Congress (Sir Robert Rawlinson, C.B.), when chairman of the Royal Sanitary Commission, held at Dublin in September, 1879. During the progress of the enquiry, Sir Robert Rawlinson said:—

"235. CHAIRMAN—I wish at this point to state, for the information of the inhabitants of the better class of houses in Dublin, that I have no hesitation in saying there is not a single residence in Dublin or in its vicinity, or a single nobleman's residence in Ireland, I do not care where it is situated, which, if its drains and sewers have not been scientifically dealt with within the last half-dozen years, is in a satisfactory condition: that is, if there are any sewers or drains at all, they are in a bad, dangerous, and unwholesome condition. I have no hesitation in saying so publicly. I know these facts, and this induces me to draw the attention of parties residing under such conditions to the danger that they are running into, as if they value their money more than they value their comfort and their health,

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they may be living under conditions where their life is not worth twelve months' purchase if anything occurs to develop the elements of evil to which they are quietly submitting, by leaving their residences in such a state. Now as to Dublin; you may sewer it to perfection, you may purify the Liffey, you may scavenge, and do everything that you possibly can, but if the persons who possess wealth, and who are living in these large houses which have old drains, do not take thought and get their premises properly examined, and face the expenditure, they will continue to live under conditions that must tend to great discomfort, and probably to shorten the lives either of themselves or some members of their families. Unfortunately, in one respect, these things cannot be done without cost. But the question every person should consider is, whether there is anything in this world that is of more value than means of comfort and health. I do not know of anything that can be compared to them."

This most important verbal public statement concerning Dublin, true absolutely in substance and in fact, was followed by the more deliberately considered written report to the Queen; no apology is needed, for the repetition here of the impressive words of such men as the Royal Sanitary Commissioners:—

Report of Royal Sanitary Commission, Dublin, 1879, on House-Drainage.

"*The evidence laid before us leads to the conclusion that house-drainage in Dublin is extremely defective, and we have reason to believe that this is the case in all classes of houses.* The house-drains, from the description given, would appear, in the vast majority of cases, to consist of loosely constructed rubble-walled channels, resting on the soil beneath the basement, and from their imperfect construction presenting numerous points of leakage, through which sewer gas and fluid sewage escape and saturate the sub-soil. Most of these house-drains were originally laid down with a view to the carriage of little more than waste water. Since the date of their construction, however, and especially since the introduction of the Vartry water, the abundant, constant, and high pressure service provided by this source of supply, has tempted house-owners largely to increase the number of water-closets in private houses; and such additional water-closets have been set up without corresponding improvement in the system of drainage with which they have been placed in connexion. The result of this attempted removal

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of excreta by defective house-drains has been sewage saturation of basement sub-soils. Under conditions such as we have described, it is not surprising that the health of Dublin should have suffered, and that the mortality from diseases classed as constitutional should have remained high. *Our attention has also been drawn to the circumstance that in another form a defective system of house-drainage extends to the connexions between the drains and the public sewers, because no systematic attention has been paid to the importance of making a proper break at the point of such connexion, and that, in consequence, house-drains form in many instances the terminal points of sewers, thereby constituting them, at high levels, the points of maximum pressure of sewer gases.* We have found that in houses of modern construction upon suburban sites, the builders have taken no proper steps to break the house-drain connexion with the houses.

"The extreme importance of providing all houses with properly designed and constructed air and water-tight drains will be more readily appreciated by a consideration of the nature of town-sewage and the dangerous gases it is capable of producing and setting free."

ROBERT RAWLINSON, C.B.
F. X. MACCABE.

Out of more than one thousand dwelling houses inspected in Ireland, from noblemen's mansions to six-roomed cottages, only twenty could be truthfully certified free from danger to the health of the residents. No selection of these houses was made; they were examined in the order in which they were placed on the books. About fifty of these were tolerably secure though faulty, while twenty only were found free from defect.

This is not a mere statement of opinion, but a record of carefully ascertained facts.

Allotting 10 persons to each house, we have here over 10,000 persons living under conditions where their lives were continually in needless danger, and where it is known that many from these causes suffered serious illness, in some cases ending fatally.

Taking 550 inspections, of which the writer has preserved very accurate records, the details show the following results:—

480 house-drains so ill-arranged and constructed that foul gases of cesspools or public sewers had free entrance into the dwelling.

259 old-built drains of deposit acting as long foul cesspools under kitchens, pantries, and basement bed-rooms, and generally having rat burrows into the basement.

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416 drains leaking sewage into basement sub-soil.

397 drains having defective junctions.

162 drains dangerously choked with foul deposit.

238 drains devoid of arrangement for ventilation, besides many modern unventilated pipe-drains conveying the concentrated foul air of unventilated cesspools direct into dwelling, as shown by smoke-test.

Many modern pipe-drains broken, or laid with open joints, leaking sewage into basements.

440 scullery sinks, so dangerously connected direct into drains, that polluted air flowed thence into houses day and night, as shown by smoke-test.

198 water cisterns supplying drinking water polluted by foul air from overflow pipes in connection with drains, or by surrounding impure air.

Many soil-pipes with open joints passing through pantries or larders, polluting milk, butter, meat, &c.

60 ashpits or cesspits dangerously located against house-walls or under basement of return buildings.

A list of fifty-one specific insanitary and dangerous defects actually discovered during sanitary inspections in dwelling houses may prove a serviceable indicator for enquirers.

1. Common brick or stone built drains under basements.
2. Large, built drains, under or near dwellings.
3. Pipe drains of larger diameter than actually necessary.
4. Pipe drains broken, or with leaking joints, saturating the sub-soil with sewage.
5. Pipe drains with built or imperfect junctions.
6. Pipe drains under dwelling without sufficient fall.
7. Pipe drains with fall in the wrong direction.
8. Drains of any kind without proper intercepting traps.
9. Drains of any kind without constant free current of air throughout.
10. Drains without easy means of inspection.
11. Drains carried from public sewer direct under hall door steps and under scullery floor instead of across open area.
12. Rat burrows from built drains undermining floors.
13. Rat burrows from public sewer worked along outside pipe drains into houses.
14. Defective connection between soil pipes and drain.
15. Soil pipes inside houses under almost any circumstances.
16. Soil pipes inside or outside without any or ample ventilation.
17. Soil pipes through pantries, larders, or stores.
18. Defective or ill-constructed water-closet apparatus.

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19. Water-closet cisterns with overflows joined to soil pipe or drains.

20. Safe trays under water-closets joined to soil pipes or drains.

21. Two or more water-closets or sinks on one soil pipe, untrapping each other when used.

22. Overflow pipes connected to soil pipes liable to become untrapped.

23. Water supplies over troughs taken from water-closet or other contaminated cisterns, and liable to be used by careless servants to fill bedroom carasses for drinking.

24. Taps for supplying bed-room water fixed over housemaids' slop sinks, liable to be polluted by splash from slops emptying.

25. House cisterns, with overflows, joined to soil pipes or drain.

26. Traps of every kind, without ample ventilation to guard them.

27. Scullery sinks connected direct to drains, admitting foul air not only through traps but through joints of brickwork and plaster all round.

28. Bell traps, with loose covers on scullery sinks.

29. Gullies or traps in floors of sculleries, laundries, larders, or basement, &c., connected to drain, and usually dry and untrapped.

30. Ventilating foul air shafts, discharging near chimneys or windows or ventilating openings.

31. Rain pipes used as ventilators for drains, discharging foul air near bed-room windows or under roof eaves.

32. Rain pipes used as or connected to soil pipes, likely to freeze soil pipe solid in severe winter.

33. Rain pipes passing down centre of houses connected in any way to drains.

34. Open rain courses from valley gutters, passing under floors to outside down pipes connected to drain.

35. Rain pipes of low roofs, bow windows, or porches connected direct into drain.

36. Ashpits located near larder, pantry, or dwelling.

37. Ashpits liable to let moisture soak into house.

38. Ashpits capable of retaining moisture, or unventilated.

39. Rat burrows from defective drains in neighbouring premises.

40. Defective drainage or fittings in neighbouring premises.

41. Any direct communication with drains of neighbouring premises.

42. Water tanks in areas, near ashpits or sculleries, or with any connection of overflow to drain.

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43. Bath waste or overflow pipes connected to soil pipes or drains.

44. Washhand basin wastes or overflows connected to soil pipes or drains.

45. Water-closet cisterns under bed-room or parlour floors.

46. Cesspools near houses, or unventilated anywhere.

47. Cesspools or drains near wells.

48. Drains crossing your house from neighbours' premises.

49. Field or surface-water drains, with open joints, under basement connected to house drains direct.

50. Damp basements or damp walls.

51. Drinking water defects of source, supply, or storage.

Each defect mentioned here, and how to avoid it, would occupy an essay in explanation, but in the brief time at our disposal we must pass them by in naming them, and endeavour to deal practically and usefully with one point of paramount importance in house inspection—the house drain.

Let us consider the house drain under two distinct sections.

The first section is that laid by and under the control of the sanitary authority, from the public sewer across the roadway up to the outermost wall of the premises drained, inside which limit the sanitary authority does not go.

The second section is that laid by and under the control of the occupier or owner of the houses and premises, beside, around, or under the houses, as circumstances require.

The opinion has long been held and is growing steadily that we are making very serious mistakes in Dublin, decidedly injurious to the health of the citizens and increasing the death-rate—

1st. By using pipes of 9 in. diameter for the house-drain, laid across under the streets, connecting the houses with the public sewers.

2nd. By laying them on the soil without cement concrete foundation, and so that they are liable to sink.

3rd. By not imperviously cementing the joints.

4th. By leading them into the house direct under the scullery instead of invariably leading them across under the open area.

5th. By not compelling the use of approved Interceptor traps to exclude the public sewer air.

The 9 in. diameter drain-pipes used in Dublin are 50 per cent. too large in diameter and area for their purpose of conveying drainage rapidly from the houses into the public sewer.

The speed and carrying power of the ordinary water flush sent through a 9 in. drain is very much less than the same would be through a 6 in. drain. This may be illustrated by sections of the two pipes, 6 in. and 9 in. diameter, and 3 feet long

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each, glazed transparent at each end. An ordinary flush of two gallons of water poured into each shows 3¼ inches depth of water in the 6 in., but only 2½ inches depth in the 9 in. drain.

This water, when flowing, will be attenuated to 2½ in. and 1½ in. deep respectively.

Here, then, the power of carrying solids is evidently much greater in the 6 in. drain, because the water is deeper and the friction surface of pipe less extended. If we could prolong these two drains 50 feet, giving to each an equal inclination, we should find the two gallons of water flowing through the 6 in. drain at much greater speed and force than in the 9 in. drain. The smaller drain would carry the solids along more effectually, and therefore be less liable to hold deposits or to choke than the 9 in. drain. Of course, if we extend the experiment to a 12 in. diameter drain (a size which was specified recently as proper for draining a house in Sackville Street) we find that two gallons of water will not do much more than just wet the bottom of the pipe.

It is very important that the proper size of house-drains should be adopted in a great city. Dublin City, exclusive of suburbs, contains more than 25,000 houses in about 130 miles of streets, with a population over 250,000. Taking 7 yards or 21 feet of drain under Section 1 as a fair average for each house, we have 100 miles of drain laid across under roadways from houses to sewers under the control of the sanitary authority.

The length of private house-drains and branches, beside under and around houses, extends many hundred miles more, but at present we are only dealing with the section under the sole control of the sanitary authority.

Now, the internal surface area of this 100 miles of drain is more or less foul, and is constantly giving off exhalations to the air in the drain, the proportion of this internal surface area of 9 in. to 6 in. drain is as 2¼ to 1½, *i.e.*, the 100 miles of 9 in. drain now laid under our streets and connected with our houses contains 1,188,000 square feet of foul surface area inside, as compared with 792,000 square feet the surface area of 6 in. drain, an absolutely unnecessary excess of nearly 400,000 square feet of foul surface in our drains.

The manipulation of 9 in. drains is very much more laborious than with 6 in. drain, as may be seen by considering their respective weights.

The weight of a yard of 9 in. drain is 90 lbs., and of 6 in. 56 lbs.

The weight of a 9 in. interceptor trap is 130 lbs., and of 6 in. 70 lbs.

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Therefore, in laying the 100 miles of cross drains, and the interceptor traps for our 25,000 houses, an unnecessary dead weight of 3,270 tons must be carried and manipulated, or 8,450 tons of 9 in. as compared with 5,180 tons of 6 in. diameter.

The difference in the cost of 100 miles of 6 in. and 9 in. drain is also well worth public attention.

The first cost, sea-freight, land cartage, warehousing, accidental breakage, workmen's time handling, excavation of trenches, refilling and packing trenches, cement foundations, cement joints and interceptor traps—all cost much less for 6 in. than for 9 in. drains. An estimate of these items will show that a total saving in cost to the citizens, if the more suitable 6 in. diameter drains had been used, would be a capital sum in round numbers of at least £25,000, and a very notable saving in money may be effected in future if 6 in. drains are adopted, besides the saving to life and health.

The importance of forming a hard unyielding foundation for the drain should never be forgotten. Concrete formed of one part Portland cement to four parts clean coarse gravel, laid in a layer at the bottom of trench (between two boards afterwards removed), 3 in. deep by 6 in. wide, on ordinary ground, or 4 in. deep by 9 in. wide, on soft yielding ground, will form a sound foundation. It should be given the proper fall equally throughout, as carefully determined beforehand. The drain should not be laid until the concrete has set hard. As the laying of drain proceeds cuts or hollows, partly across concrete, should be made about 2 in. deep, and only sufficiently wide to receive the sockets of the pipe drain in such a manner that they shall lie over and in the hollows without touching any part, thus distributing the weight on each length of drain resting on the hard foundation, instead of allowing the whole weight of drain to press on the sockets, while from socket to socket the drain hangs unsupported, though pressed on by the weight of earth above.

If an unyielding foundation is not formed the drain will sink at certain points, forming dips or festoons underground, which cause stoppage eventually. These points have been noted by sanitarians often, yet sanitary authorities permit the continuance of the ancient defective and dangerous system. The chief difficulty we find in securing sound drains lies in the fact that they are laid and hidden underground. The aim of sanitary engineers should be to bring them to the light, and so to arrange their drainage that each portion shall be within easy inspection and cleansing distance.

There is no valid defence for the dangerous practice of laying drains dry without stanch joints. Drain layers when asked

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why this is done, say it is in order that the pipes may not have to be broken when they are removed or altered!

Of course we know that drains ought to be laid down with the object of fulfilling their purpose of being sound and stanch to carry drainage safely for the health of the citizens, rather than with the ulterior object of removing the pipes safely at remote periods to the risk of the citizens' health in the meantime.

Perhaps the open joints may drain the subsoil, but if they admit sub-soil water in wet seasons they will allow the escape of liquid sewage to saturate the soil in dry seasons, and at all times permit the escape of sewer air in a dangerous manner.

The insufficiency of clay or soft yielding material has been clearly demonstrated, but it is still tenaciously defended by many professional men on the ground that clay yields if unequal pressure comes on any part of the drain and thus saves the pipe from fracture.

Here we actually find the dangerous elements of bad foundation expected and calculated upon, else the drain could not yield even with clay joints; we find the neglect of careless filling in over-pipes so as to cause unequal pressure looked for, and we find apparent forgetfulness of the fact that if a drain sinks or falls below its true level or inclination it is no longer a safe and reliable drain, but contains, whether fractured or not, dips or hollows which retain the drainage dangerously, and therefore such drain ought to be removed.

Clay will of necessity wash away out of the joints, as little by little the passing water disintegrates it. Portland cement is the best, the easiest obtained, and the most simply applied material for earthenware joints.

Roman cement is now little used, and experts have condemned its use for house-drains on the ground that the chemical action of sewage affects it injuriously and converts it into mud.

The dangers of this open-joint system are very serious:

1st. The open joints allow the escape of the water which is carrying the solids along, a portion escaping at each opening into the surrounding earth, till the liquid remaining is insufficient to carry on the solids, and they are deposited in the drain, and eventually cause a stoppage, which cannot perhaps be cleared until the drain is opened up.

2nd. The soil surrounding the drain becomes saturated with liquid sewage, which decomposes and becomes dangerous.

3rd. The drain is more liable to settle unequally, making hollows underground in which solids accumulate.

4th. The three or four joints nearest to the house under the coal-vault or scullery, being open, allow the foul sewer-air to be

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forced rapidly through them into the house, and thus, owing to the rarified condition of the house-air, the foul air is pressed in day and night, unsuspected and in large quantities, as explained in diagram.

The discharging or sewer ends of the 9 in. pipe drains under roadways in Dublin are built into the walls of the public sewer, and these sewer walls are found sometimes so close to the outer walls of the coal vault adjoining the scullery as to appear formed by the one wall.

If breaches occur in these cases, caused either by too careless workmen or by too careful rats, the dangerous effect will be the same in either case.

Instead of allowing a mason to build well or ill according to his humour round the drain-pipe at its outfall through the main sewer wall, special glazed earthenware blocks should be used in each case, built carefully and neatly into the wall, and the drain should then be laid from them towards the house.

These blocks should be splayed to deliver the drainage current in the direction of the main sewer current.

One most important point in connection with this subject, which does not appear to have been considered, is the proper point or position in front of the houses to which the drain should be laid by the sanitary authority, and left for the house-drain to be connected with.

In the great majority of cases in Dublin the drains are laid in from the public sewer to the coal vault adjoining, and opening direct into the scullery under the hall steps, and therefore in direct unbroken connection with the kitchen and the dwelling.

Many deaths and much illness have been caused by this dangerous position for entrance of drains taken in connection with the open joints on the drains. Rats frequently make burrows along the outside of pipe-drains at this point to get from public sewer into houses, admitting the foul air also, which neither cat nor trap can catch.

The law or the sanitary authority should require all drains to be brought into the open areas in front of houses, and should forbid all direct drain connection under any vaults having direct covered access to the houses.

That interceptor traps are required on the line of drain, at some point before they reach the houses is held by sanitary engineers and now generally admitted. If interceptions choke, the fault lies in bad form, defective fitting, or insufficient flush, combined with the total neglect of observation on the part of the householder. There are now several forms of interceptor which in 6-in. size will clear every time an ordinary flush is used, nevertheless they should be fixed and arranged so that they can be easily inspected,

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and that any serious stoppage will reveal itself at once on the surface. The fact that the drainage of all the houses in the streets on higher level than yours must pass by the mouth of your house drain, and that possibly this drainage is further polluted by the drainage from fever hospitals, which also discharges into the public sewers, ought to afford sufficient reason for the importance of intercepting sewer gas traps on private house drains. Their absence frequently allows infectious diseases to spread from house to house; indeed, without interception and thorough ventilation a system of supply and conveying infected drain air into houses exists, similar to that adopted by the water works committee for the purpose of supplying pure water, the only difference being that in the case of polluted sewer air the pipes are 9 in. diameter instead of ½ in., and the supply is unrestricted. Householders can have any amount of dangerous sewer air, but pure Vartry water must be very carefully and sparingly used, or the water inspector will cut off your supply at seven days' notice.

The diameter of interceptors generally corresponds with the diameter of the drain. Here may be seen a 9 in. and a 6 in. interceptor, side by side, for comparison of one of the best forms. You observe the necessarily large, clumsy, unmanageable dimensions of the 9 in., and the handiness of the 6 in. for manipulation, and you can at once see that no ordinary house-flush of two or three gallons of water would clear the larger trap, and consequently that foul deposits would be likely to remain, decomposing dangerously, and finally will choke the trap and drain unless a flushing tank is in use to discharge large bodies of water at intervals through the drain and trap. The need of these interceptors afford a very strong reason, therefore, in favour of 6 in. drains over 9 in. The two traps standing side by side ought to convince you.

The sanitary authorities do not provide or fix intercepting sewer gas traps on the section of drain under their control, the ends of the drains are left open, and the option of using interceptors is left with the householder, consequently drains are being daily laid without interceptors, or with interceptors of too large size and bad form, which choke in a short time and are worse than useless. Intercepting chambers should be placed in the open areas in front of every house, easy of access, and furnished with air-tight iron covers and abundant ventilation.

It might be a fair question for consideration whether the sanitary authority or the householder should provide this chamber, but I strongly incline to the opinion that it should be the duty of the sanitary authority to lay the drain from the public sewer in a straight line into the area, in every case also

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providing and fixing a uniform intercepting sewer-gas trap on the house end with a splay junction to enable the drain to be cleared, while the building of the chamber, together with the house-drain and branches, at the house side of the interceptor should be the duty of the householder. This is common sense; the sanitary authority thus controls and prevents escape of the foul air of their sewers into houses, and no dispute as to position of interceptor can arise, as the angles at which house-drains join the intercepting chamber may vary, provided it be in the open area.

These intercepting chambers can be seen at the Exhibition.

Summing up the evidence on the question of the diameter of the drain we find that—

A 6 in. drain will carry sewage better and quicker than any larger size; that it is easier carried, lifted, cut, and manipulated; that the internal surface area giving off bad air is much less; that its interceptor is easily flushed; and lastly, that the cost is much less, an advantage sometimes appreciated above all others.

Some of our sanitary authorities still approve of 9 in. pipes for house-drains, but if this Congress shall be the means of convincing them that 6 in. pipes are better, the benefit to the citizens will be so great that it shall not have visited Dublin in vain.

The health of Dublin would be notably improved if the sanitary authority undertook a systematic examination and test of every house-drain, and compelled their universal reform. Practical sanitarians will be found in favour of stringent inspection and supervision of sanitary work, especially where it is hidden or covered up. They aim at having as much exposure as possible, and seek to arrange every part so that it may be easily seen and cleaned.

We hold that the sanitary authority of every city should keep plans, not only of the public sewers, but also of the branch cross drains as far as the interceptor in the areas, for reference.

There should be a stringent official inspection of the internal fittings of every house.

Although honest and capable contractors might be caused additional trouble where the special care needed is already exercised, yet such men would press for this salutary supervision of all, and even find benefit from it, in face of the terrible amount of downright bad and dangerous work which is done.

The manner in which unsanitary work has been, and still is, done is something awful, considering all the future evils it is working out with the certainty of a mathematical problem.

Turning now to Section II.: the private house-drains solely

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under the control of the householder; there are two classes, drains inside the house walls and drains outside the house walls.

If it is possible to place drains outside the walls we are all agreed that they should be kept there even at considerable trouble and expense.

In the great majority of cases, however, in towns the drains must pass under the basement floor inside the house walls to convey drainage from the back of the house to the public sewer in front street.

No kind of work causes greater anxiety to an honest and competent contractor than the laying and jointing of drains underneath dwelling-houses entrusted to his care, for he knows that the health and perhaps the lives of the residents will be dependent on the soundness of the work.

Thorough sanitary inspections have revealed, among many other dangers, the scandalous manner in which pipe drains are sometimes laid under houses. We could name at least six householders in one of our fashionable Dublin squares who ordered new pipe drains to be laid under their houses, but were soon compelled to incur all the worry and expense of ripping them up and laying new drains properly, because the work had been ignorantly planned and carelessly executed. One cannot wonder at the deep concern and indignation of householders in such circumstances, though one does wonder why it is that the cost is so much considered in such vitally important work. The contractor is expected to lay drains and to become responsible for them at less per foot run than would be paid for a gilt moulding round a drawing-room.

In view of the extreme importance of sound work in drains and fittings, does it not seem the most extreme folly to try to get such work done at low rates? If tenders are invited and sanitary work allowed to be competed for, and given to the cheapest contractor, how in common sense can the best work be expected?

The drain is laid, and the evil results may appear soon or perhaps not for years, but eventually cheaply, rapidly-laid drains have to be ripped up and new drains laid at a cost of double the original value.

The present habit of some contractors scamping work is very largely due to the present habit of some employers scamping the amount to be paid for it.

Good work costs good money and cannot be had without it, and the sooner the community learn that they are losing fast in permitting competition for work involving life and health, the better will it be for the community.

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The health of a household depends very much on the durability as well as on the initial soundness of each joint and piece of drain.

It is easy enough to lay a drain as drains go, or rather as drainlayers go, by rule of thumb, but to lay a drain sound and well is very difficult.

Passing by the difficulty of jointing, there remains the difficulty of obtaining earthenware pipe drains sound, true, and straight, so much as 60 per cent. having to be rejected from some lots even by the best makers. This has turned attention to cast iron as a suitable material.

You can see a specimen in the Exhibition that will bear a pressure of 300 lbs. per square inch without leaking one drop; there are also specimens of traps and all connections likely to be needed. Cast iron drain pipes to be desirable must be heavy, with turned and bored or leaded joints, and coated with a preservative solution. They are then naturally true in circle, straight in run, and strong to resist outer or inner forces.

There are difficulties, of course, requiring to be surmounted, but all can be overcome as they occur. Costly patterns have been prepared for every form of connection likely to be needed. There is no form of trap or junction made in earthenware that may not be easier and better made in cast iron once the cost of pattern-making is met.

The earthen drain is made in 2 ft. and 3 ft. lengths, requiring three or four joints of doubtful quality, when a 9 ft. length of cast iron drain can be laid in at once, with a perfect joint capable of resisting 300 lbs. pressure.

Cast iron drains may be laid close to the surface, or even over ground, with absolute certainty and security, free from the dangers attendant on concealment.

Nothing, however, that can be done to secure a perfect drain can compensate for the danger incurred by carrying the drain under the scullery and coal-vault to the sewer in place of carrying it across under the open area, or so that an open air space may occur between the house and the public sewer on the line of drain. I have not seen this danger pointed out before, but it is so common in Dublin that I wish to press it very specially on the attention of this Sanitary Congress, and of all persons engaged in the arrangement of house-drains.

This common and dangerous course of the house-drain leaves an unbroken line of covered-in connection between the public sewer and the house along the course of the drain.

Our sanitary inspections have revealed rat-burrows carried direct from the sewer, and outside along the pipe-drain into the coal-vaults and scullery. A rat-burrow once so formed supplies

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a constant dangerous inflow of foul air from the sewer into the house. By the same inspections pipe-drains have been found laid inside the old square-built drains, so that the foul sewer air, with an occasional rat overture and accompaniment, had free access to the house. Inspections have also shown cases where the drain layer forgot to close up the opening made into the public sewer for the pipe drain from the house, and as this neglect occurred in the vault off the scullery, of course the foul air freely flowed in.

A coal vault under the footway or road adjoining a scullery with any door or opening between is always unsafe and often highly dangerous, even without any drain passing under it to the sewer. It is generally preferred as a convenient coal store by the cook, who thus has not to go out into the air to bring in coals from an outer coal vault. Foul air is always percolating more or less from the public sewers or from leaking gas mains, or from the surface of the street, saturated as it always is with foul matters, through the soil and through the walls and floor and arched roof of such a vault, forced in by the heavier column of cold air outside, upweighing the lighter rarified column of warm air inside the house.

There should be a rigid law that no vault under the road or footpath should have any opening into a house direct. That every subway vault should only be entered from an open area, and that the wall dividing such vault from the scullery or house should be cemented imperviously to exclude from the house all bad or doubtful air that may find access to the coal-vault.

If circumstances are such that the house-drain must be laid or remain under the scullery and this vault, the vault should then be concreted, and the doorway built up and cemented, and an entrance or access hole made through the wall dividing this vault from the next vault off the open area.

The fact still remains that the only proper course for a house-drain (when it must pass beneath a house at all) is a straight line from open back-yard to open front area, with man-hole chambers at each end, and with an interceptor and drain continued from front area chamber to sewer.

A sanitary house inspection in a Dublin mansion revealed the fact that all the public drainage of several stables in a lane behind was carried through the drain under the kitchen into the public sewer, excepting a considerable portion, which was deposited through leaking joints under the kitchen and basement floors. This stable-drain deposit was found to have nearly choked the house-drain.

When the attention of the Dublin sanitary authority was

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called to this danger, they laid a new public sewer under the stable lane, and abated the nuisance, although, legally, they might have objected to do so: a creditable instance of the readiness of the Dublin authorities to act promptly, unfettered by routine, when a case requires action.

I shall not weary you further by detailing the defects that systematic sanitary inspections daily bring to light.

The expression on a sanitary inspector's face a short time ago was one of constant surprise; now he has ceased to be surprised at anything.

He at one time cherished a hope that if a drain was highly commended in any particular house that there might be some truth in the statements; now he does not believe anything about a drain unless he sees it.

If it be happiness to be able to confide and trust in those you are brought in contact with, the sanitary inspector cannot be a happy man. He can trust no statements about drains or fittings at all.

When house-hunters discover a suitable residence, and they ask invariably concerning the state of the drains, what answer can they expect to receive?

If the owner is asked, probably he knows no more about them than the questioner.

If he knows that the last tenants suffered illness in his house does he usually say so, candidly?

But if somebody told him, that somebody said, that somebody else, had somewhere read that the drains were really no worse than in other houses, does he not use the statement liberally, and finally bring himself to believe and say that he has been informed by some sanitary authority (probably his ashpit cleaner) that his drains are excellent drains and in very good order?

If the house-hunter is dealing through house agents how is the question concerning the drains answered?

House agents in duty to their clients are almost bound to believe that their drains are either good, better, or best; they are wise not to encourage or make any inquiry whatever about such matters; they are not sanitary engineers, and it is their simple business and duty to their client to let the house as you see it overground, and not to poke into the drains which are underground and away out of sight. Great sympathy should be felt for house agents in this matter, they should never under any circumstances be asked concerning the drains of any house they are trying to set. You lead them into a temptation which it seems almost a positive duty to their clients on their part to yield to.

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If an owner or a house agent told you that he had some doubts about the drains in the house you were looking at, would any of you, in your senses, take the house?

When a proportion of about 1200 houses out of 1250 examined were found badly drained, would not house-hunters act wisely to see and to test the sanitary arrangements before believing in their reputed excellence?

If a sanitary engineer, who knows his business, be employed to make a sanitary inspection, he will make no statement in his report which he cannot verify; he will neither believe nor ask others to believe his report unless he can point out the defects he states to exist.

That is our strong point and vantage ground when assailed by landlords, by house agents, and even by the very house-hunters themselves, who may wish to take the house owing to its outward attractions and suitability, and may want, therefore, to be told that it is a healthy house. We sanitary inspectors, if we know our duty, simply answer and say "come and see."

It does seem odd to us day after day to be consulted by house-hunters as to our opinion concerning No. 10, Blank Square; whether we don't think it is healthy, because the agent or the owner says that the best sewer in Dublin passes in front of it, and that the late tenants were healthy. We would positively be thanked, and considered very smart and intelligent (not merely by the owner or agent, *cela va sans dire*, but by the intending tenant, interested in knowing the exact truth) if we at once, without seeing the house, or knowing anything of the actual facts, declared that, in our opinion, the house must be a healthy house. The inspection fee would be saved, at all events, and the trouble of further house-hunting avoided.

Although sanitary principles are now well established, their application in sanitary work will not be complete in detail for some time. Like electric lighting, sanitary reform needs careful nursing to develop its powers and resources and prevent mistakes. Every day some new difficulty presents itself, which taxes the inventive powers. We see in the Dublin Sanitary Exhibition many new forms of traps and connections, designed to overcome difficulties met in practice, some of which are successful, and become universally adopted, while others pass away and are forgotten.

As the writer passed through the ordeal himself, he can strongly recommend to all sanitary inspectors some such course of study as that prescribed by the Sanitary Institute of Great Britain, followed by the examination before the Board of Sanitarian Specialists, held biennially in London for the purpose of qualifying practical men for duty as sanitary surveyors.

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The sanitary inspection of a dwelling, when undertaken by a Sanitary engineer, should be considered by him as a sacred trust, to be carefully and faithfully carried out for the protection of the health and the lives of the future residents. The suggestions of interested persons, too often made, in order to mislead or prejudice the inspector, should be cast aside, and an unbiassed judgment formed and expressed in the report, founded solely on ascertained facts, capable of proof if questioned.

The public are not easily convinced of hidden dangers when money has to be spent in order to avoid them. They will chance being caught by such preventible diseases as typhoid and cholera, rather than face the trouble and cost of getting beyond their reach. Many householders bring certain death on their first-born rather than take the little trouble necessary to secure the passing over of the Angel of Death.

It has been said that in questions of sanitary reform some of us, like the Israelites, require a plague to make us do our duty, while others resemble the Egyptians, who refused to be convinced at all. Many of the sanitary reforms determined on in 1866, when cholera visited us, remain yet to be carried out, and if another plague comes we shall be found unready.

Is not the often repeated advice of family doctors in sanitary matters constantly neglected by the heads of families living in dangerous houses, who harden their hearts not to believe in the danger that exists; or, believing, postpone facing it until illness or death comes to them or their children? People are more willing to take a doctor's nasty medicine than his sound advice, which would, if taken, save them from the need of his medicine.

To the steadfast unselfishness of medical men in connection with voluntary sanitary work, far greater honour is due than a careless public has ever yet paid.

Typhoid, diphtheria, and other preventible diseases, must add largely to their incomes, not only as a profession but individually, and yet we find hundreds of doctors, in pure unselfish pity for human suffering, going far out of their way to advance sanitation and suppress these diseases—cutting down their own incomes and earning the dislike and enmity of the wealthy, the landlords, the Poor Law Guardians, and the very classes on whom their incomes must depend, while they labour day and night to benefit the sick and suffering poor who can never repay them. I think there is nothing grander than the quiet heroism of the daily life of such men as these.

In conclusion, while thanking you for your attention, let me claim for the systematic sanitary inspection of houses a more important place in our social economy, as year by year passes and men become more alive to their real interest in such

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matters; and also let me ask, on behalf of all men honestly engaged in sanitary work, that respect which they are entitled to in working for the public health; from the drainlayer and plumber, who faithfully perform the work entrusted to their care, to the chief engineering inspector, whose wisdom and experience frame our sanitary laws. Upon the man, whether high or low, who wilfully or carelessly scamps the sanitary work, on which he knows that the life and health of his brother depends, we call down unmitigated scorn, and desire to see stringent legal penalties enforced. It remains for me now only to say that it is the duty and the interest of every householder to take advantage of the various means of sanitary inspection and reform of houses now open to him; to secure himself and his family from many of the dangers which threaten our houses; and I conclude, not with the well-worn English proverb, that "Prevention is better than cure," but with our Irish version of it, "The best way to prevent what's past is to put a stop to it before it happens."

[*For discussion on this paper see page* 302.]

On "Some Defects in House Sanitation in and around Dublin," by P. F. Comber.

The Council of the Sanitary Institute having invited the co-operation and support of all who are interested in the diffusion of sanitary knowledge, I beg leave to describe briefly some serious defects in house sanitation, which in my professional experience have come under my observation, in Dublin and the neighbourhood.

Water Supply.—The Vartry water, which is supplied at high pressure to Dublin and the neighbouring townships, does not leave much to be desired if the water be used direct from the main; but the way in which it is sometimes stored for domestic use is most objectionable and dangerous to health.

I was called upon some time ago to make a sanitary inspection of a terrace of houses in a fashionable locality, the rental of each house being about £100 a-year. The terrace was supplied abundantly with the Vartry water, but each house had a cistern to receive the water, and in every case the cistern was placed partly in a covered ash-pit and partly in the servants'

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water-closet adjoining. There was no ceiling to either the ash-pit or the closet, nor cover to the cistern to protect the water from dust or from being contaminated by the poisonous gases arising from decomposed vegetable, and other organic matter. The cistern also served the servants' water-closet by means of a stool-cock. And yet, incredible as it may appear, the occupants of these houses used the water for drinking and cooking purposes.

The cisterns were abolished after being in use upwards of a quarter of a century, and as they had not once been washed out during that period, their sanitary condition can be better imagined than described.

Water for drinking purposes is frequently drawn from water-closet cisterns, which are rarely, if ever, cleaned out, and very often they are so placed that they are inaccessible for that or any other purpose.

Drainage.—As a rule the house drains are too large and are not laid with sufficient fall nor with uniform gradients; 9 in. and 12 in. drain-pipes are used where smaller drains would be more effective. And the old square-built drain with flat bottom still exists in many houses. The main drains are not always taken direct from each house to the public sewer, but are connected with the drains of the adjoining houses, and they are not disconnected from the sewer, nor ventilated, except in the comparatively few houses where more approved and scientific principles have been adopted within the last few years. Waste-pipes and rain-water down pipes are to be found entering the drain direct, and frequently without a trap of any kind. Soil-pipes are seldom properly ventilated. An attempt is sometimes made to do so by carrying up a small bore pipe (½ in. or more), from the soil-pipe, and terminating it not unfrequently near a bedroom window.

The workmanship too in many instances is very defective. I have seen drains passing through and under a building with the joints laid dry without cement or other jointing material; and the connections of the drain pipes are frequently very imperfectly made, without proper junctions, simply by breaking a hole in the side of the main drain pipe, sticking the branch pipe into it and jointing with pieces of brick and mortar. And these defective connections are often made within the building. In cases of this kind the rats are afforded free ingress and egress to and from the house through the drains. I examined a house a short time ago which was infested by rats owing to this cause. They had a free run between the house and the public sewer, as the house drain was not trapped. Where the house drains are so defective the sewage gas has of course free

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entrance into the house, and the ground on which the house stands becomes foul by the escape of sewage matter from the open joints of the drain-pipes; and the house itself is connected with the adjoining house through the drains probably with as much danger in case of infectious disease as if there were a doorway from one to the other.

I have seen a house-drain, not far from the City, which, perhaps, deserves to be mentioned. The drain ran under and through the building to the public sewer in the front, and was originally square-built with flat bottom, and about 14 in. by 12 in. in sectional dimensions. Subsequently a 9-in. stoneware drain-pipe was put down, which was simply laid into the square-built drain with dry joints, and the old drain was covered over with rough flags as before. When I examined the house I found that the old drain had become a receptacle for sewage matter passing through the open joints of the enclosed drain-pipe; and it is needless to add that foul odours were experienced by the occupants of the house.

Ventilation.—Special provision for ventilation is very rare, except in some modern houses; and even the ordinary means of preserving the purity of air in rooms by the proper use of the windows is not generally resorted to or appreciated.

The drawings illustrate the defects to which I have referred, and also the proper method of house drainage.

No. 1 shows defective house drainage.

No. 2 shows the cistern in the ashpit from which water was drawn for drinking and cooking purposes.

No. 3 shows the house drain arrangements for detached houses, based on the model bye-laws.

No. 4 shows the house drain arrangements for semi-detached houses, ditto ditto.

No. 5 shows the house drain arrangements for attached houses, ditto ditto.

No. 6 shows in detail two methods of disconnecting the house drain from the public sewer.

[*This discussion applies to the four preceding papers by* Mr. G. B. Nichols, Mr. W. Kaye Parry, Mr. W. R. Maguire, and Mr. P. F. Comber, *which were discussed conjointly.*]

C. P. Cotton, M.Inst.C.E. (President of the Section), said that under the 25th section of the Public Health Act a sanitary authority had power, where a proper drain was not made from a house to the

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main sewers, to require it to be of such materials, size, and construction as they might think necessary.

Mr. J. Rawson Carroll (Dublin) said that if the section of the drain instead of being circular was illiptical it mattered not what quantity passed through it, because there would always be about the same amount of flush. He thought that in all the arrangements they advocated they should keep economy in view; for if people got into their minds that calling in an architect or engineer to improve their drainage meant heavy expense, he was afraid they would not be often called in, and the work would be unskilfully done.

Mr. Parke Neville (City Engineer, Dublin) thought the condition of Dublin had been much exaggerated in these papers. It was impossible that every system of sewerage could be water-tight. Workmen, although they gained nothing by so doing, scamped their work. When he became engineer to the Corporation there were practically no pipe drains—the old fashioned square drains, built of rubble masonry, were general. He was anxious to use medium-sized pipes, but the people almost rose in rebellion about it, and the 9-inch pipe was introduced as a compromise. He knew 6-inch would, in many cases, be sufficient. Most of the house drains in Dublin run right through from the back door to the front door. They constantly had complaints about house drains, but when these people were asked to lodge £5 or £10 for the expense of substituting pipes for old brick drains they instantly went away.

Mr. Stirling (Dublin) thought that if the clauses of the Public Health Act were enforced there would be few of the defects mentioned in these papers.

Mr. D. Emptage (Margate) said that in dealing with house drainage they must not overlook the fact that, no matter how completely their drains were disconnected or thoroughly ventilated, if they had a defective apparatus, such as a "pan closet" fixed at its head, bad gases would be generated in its own cesspool (very properly designated a container), which would belch forth upon the tilting of the copper pan, causing smells as offensive and, in some cases, as dangerous as bad air from the sewers.

Mr. R. O'Brien Furlong (Dublin) hoped the Section would bear with him if he intruded amongst so many engineers. When he was Secretary to the Royal Commission, which sat in Dublin in 1879, he learned sufficient about house drains to enable him to lay claim to some knowledge of the subject. The Congress had heard a good deal of the necessity of a system of intercepting sewerage for Dublin with the object of purifying the Liffey. He ventured to say that important as that subject was it was of infinitely more importance that the drains and sanitary arrangements of the Dublin houses should be put into proper condition, and so maintained. He strongly urged the necessity for periodical sanitary inspections of houses. He

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defied any man to keep his own house healthy if his neighbour's house drains were out of order. He knew business men to spend large sums in perfecting the sanitary arrangements of their private houses, while they neglected the offices in which they spent the greater part of the day. One thing which had done much to retard sanitary improvements was that engineers recommended the very best possible system, instead of a system which would be sufficient for the requirements. His advice to the public was: employ a competent person to say what the system of drainage should be, employ a competent plumber to carry it out, and then have it periodically inspected.

Mr. Rogers Field, M.Inst.C.E. (London), entirely agreed with the last speaker that a main sewerage system was not sufficient if house drainage was neglected. He had had in his practice cases without number of houses where the system of main sewerage was excellent, especially in London, but where the house drainage itself was so bad as to cause typhoid fever or other serious illness. There was one very general defect which he would specially call attention to, viz., the unsoundness of the house drains. He found this defect more frequently overlooked than any other, as it was a concealed defect, and one which was costly to remedy. In the case of town houses, where the drains so often passed beneath the house, the soundness of the drains was of vital importance. If leaky drains were left beneath the house no amount of care expended on the ventilation of the drains or on the sanitary fittings would render the house healthy. The only remedy was to remove the leaky drains and contaminated earth, and construct new watertight drains. He agreed that it was a mistake to have the house drains too large. Six-inch pipes were ample according to his experience, for any ordinary house. Many large mansions and public institutions had only six-inch pipes. Every case, however, must be dealt with by itself, and it would be wrong to lay down any fixed rule. The drains should be so constructed that everything passed into them would wash away to the main sewer. A nine-inch pipe was too large for an ordinary house, as the small quantity of water which passed would spread out on the bottom of the pipe, and not have so much force as it would if the flow were concentrated in a smaller pipe. Deposit would therefore take place, unless some special means for flushing were provided. He had generally found it advisable to make the siphon trap smaller than the drain. He frequently put a four-inch siphon in connection with a six-inch drain, and so on. The siphon should always be placed where it could be readily examined.

Sir Robert Rawlinson, C.B. (President of the Congress), said Mr. Rogers Field was called in to examine Bagshot House, the residence of the Duke of Connaught, after the Duchess was very severely smitten with disease, and to remedy the sanitary defects, and if he would state briefly what he found it would be of great interest.

Mr. Rogers Field, M.Inst.C.E. (London), in complying with Sir

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Robert Rawlinson's request, said it was a remarkable case; for the Duchess's bedroom, where she was taken ill, was a long distance from where the sanitary defects were found. He found a very defective drain underneath the basement, from which noxious gases could pass up through a hollow in the wall behind the dining room to the upper floor, upon which the Duchess's room was situate, though at a considerable distance from that point. He tried experiments by generating smoke where the foul air from the defective drains passed, but the smoke did not penetrate to the Duchess's room. Then he lighted a fire in the room so as to place the room in the same condition as would exist when the Duchess occupied it, and repeated the experiment, but still the smoke did not pass into the bedroom. He began to think that the experiment would only lead to negative results, but before giving it up he carefully considered what other conditions there could be which were not the same as when the Duchess occupied the room. He then noticed that there was no carpet down and that there were air bricks outside, and it occurred to him that the fresh air passing between the joints of the floor boards (which were not very close) might feed the fire, and interfere with the suction it would otherwise exert on the foul air in the house. He therefore determined to experiment with the carpet down. The carpet could not be obtained, but brown paper was laid down instead, and very shortly afterwards the smoke entered the room, thereby indicating how the noxious gases from the bad drain had made their way up. A peculiar fact was that until a certain day after her confinement the Duchess did not show any sign of illness. He said to himself, was it possible that that particular day she got out of bed; because he had found that the current of foul air did not pass her bed, but would pass her while sitting beside the fire. On inquiry from the nurse he discovered that the very day the Duchess first left bed and lay on a sofa beside the fire she was taken ill; next day she remained in bed and felt better; the day after she again sat by the fire and became ill again.

Mr. Clarke believed that good yellow or blue clay would be suitable for the joining of pipes. He thought every landlord should be required to give his tenant a certificate from an engineer that the house he was letting was in good sanitary order.

Mr. H. H. Collins, F.R.I.B.A. (London), thought it right to say that no worse method of joining pipes could be thought of than that suggested by Mr. Clarke; and to prevent it being accepted as a method of creating good work he had risen to enter his earnest protest against such a statement being promulgated from this Congress, as being in harmony with the practice of the members.

Sir Robert Rawlinson, C.B. (President of the Congress), said the best method of draining the house was in the long run the cheapest. London was now a water-closeted city entire, Paris remained a city of cesspools.

Mr. W. R. E. Coles (London) said that the Plumbers' Company,

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one of the oldest of the guilds of the City of London, had given their sanction and support to a General Congress of Plumbers to be held at the Health Exhibition, South Kensington, on the 28th inst., and at the Congress all the chief subjects relating to plumbing would be considered, viz.: (1.) The technical instruction of plumbers. (2.) Apprenticeship, the duration and condition of indentures suited to the present state of the plumbing trade and to the modern system of technical instruction. (3.) The establishment of metropolitan and provincial boards of examiners of plumbing work. (4.) The registration of journeymen plumbers. (5.) The suitability of materials used in plumbing, and particularly of those materials recently introduced as substitutes for lead. (6.) The desirability of fixing upon a system by which uniformity in the quality of material used in plumbing may be insured. (7.) The formation of district associations of plumbers to investigate and secure, as far as practicable, correction of evils and abuses arising in connection with the trade. (8.) A general and executive committee to be formed for the purpose of receiving reports from district associations of plumbers and others, with a view to the preparation of a general report by the Plumbers' Company, to form the basis for an appeal to Parliament for necessary amendments and extensions of the law relating to plumbers' work, under the Building and Health Acts, and otherwise.

On "Electric Lighting, considered from a Sanitary Point of View," by J. Angelo Fahie, C.E.

It may be asked at the outset, What relation is there between Electric Lighting and Sanitary Science? The author hopes to be able to show that the question of artificial lighting, and especially electric lighting, has a most important bearing on sanitation, although hitherto it has not received very serious attention from this point of view. Recollecting that foremost amongst the objects of the Sanitary Institute of Great Britain is the discussion and consideration of all questions affecting, directly or indirectly, our general health, the question of the good or evil influence exercised by artificial light thereon is of the highest importance, and is, in every respect, worthy the consideration of this Congress. When we reflect what a considerable portion of time is spent by modern society under light other than natural light, and how much more injurious are all modes of artificial lighting in comparison with sun-light, it is essential that we should consider anxiously the most desirable

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form of light which shall exercise the least ill effects on our bodily health and comfort.

In olden times man paid little attention to the subject of artificial illumination. Content to work during the day by the light of Nature, he spent his life after sunset in semi-darkness, or in the imperfect light emitted by the rude fire which served to warm his dwelling.

To the inhabitants of the East may be ascribed the first attempts at producing light by artificial means, which consisted in burning fluid bitumen in rude vessels of baked earth. Attempts were also made to utilize the fat of fish and animals for the purpose, and later on the primitive pine torch came into almost universal use as the only means of affording light after sunset. It need hardly be said that these early attempts served to fill with odour rather than light the dwellings it was sought to illuminate.

Since the object of this paper is to consider the subject of electric lighting from a sanitary point of view, and since it is only with the general introduction of gas and petroleum the danger of injury to health arose, it is not necessary to dwell on the forms of lighting in vogue prior to the illuminants now so universally used. Nor is it necessary for our present purpose to enter into the consideration of the theory, or nature of light; suffice it to say that light is the medium by which bodies are rendered perceptible to the sight. Every form of matter when sufficiently heated, has the power of emitting rays of light, and thus becomes self-luminous. All artificial sources of light depend on the development of light during incandescence.

The conditions of life under all kinds of artificial light are less favourable to health than under daylight. During the day we have abundance of soft, pure, white light. The air we breathe is pure and unvitiated; it contains the heat only necessary for health. All nature delights in sunlight, the animal and vegetable organisms flourish under its influence; our energies are in a state of activity during the day. Under artificial light these conditions are completely altered; light which would be considered excessive at night is far inferior to ordinary daylight. The heat produced by all forms of light exceeds the temperature of the atmosphere in average daylight, and the air is vitiated to an extent proportional to the amount of light produced. How desirable, therefore, is it that we should seek, and by every effort in our power assist in, the development of that form of artificial light which approaches nearest the conditions existing under sunlight.

As will be seen hereafter, the light afforded by means of

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electricity is far superior to all other illuminants in the fulfilment of these conditions.

All forms of artificial light hitherto in use depend on combustion, in order to sustain which a good and plentiful supply of air is necessary.

Gas, for example, the chief constituent of which is a combination of carbon and hydrogen, will not burn without the aid of the oxygen in the atmosphere. In the process of combustion the particles of carbon contained in the gas come into contact with the oxygen of the air, and float in an incandescent state in the interior of the burning vapour, and this constitutes the flame. The presence of the carbon in a finely-divided state may be easily shown by holding some refractory substance in the flame, when the carbon will be deposited upon it in the form of soot.

Should, however, the supply of oxygen be insufficient, partial combustion only takes place, the carbon escaping in an unburnt condition in the form of a dark cloud, when the flame is said to smoke.

The brightness of the flame, therefore depends on the supply of air necessary for perfect combustion.

That oxygen is absolutely necessary for combustion, may be shown by placing a tumbler over a lighted taper, when the taper will burn nicely at first, but soon a change will be observed: gradually the flame will diminish, and at length go out. This result is caused by the enclosed oxygen combining with a portion of the material forming the taper, producing a poisonous compound, called carbonic acid, which suffocates the flame. Similarly, if we take an Argand burner and stop the aperture in the centre, the gas burns poorly because there is a restraint to the supply of air.

The light afforded by candles and lamps does not differ essentially from that of the ordinary gas burner. The same elements which constitute the one are present in the other—they all owe their luminosity to combustion. A petroleum lamp burns imperfectly without a chimney, but when this is put on, a strong draft is caused, supplying the air necessary for thorough combustion, and the brilliancy of the flame is thus materially exalted.

From what has been said it is obvious that in order to obtain the highest illuminating power of a flame, a plentiful—and what is more, a fresh,—supply of air is essential. Thus it will be seen that wherever light is obtained by combustion it deprives the air of oxygen, that element which has justly been termed the "æriel" food of animal life, as it is dependent on it for existence. Moreover, in the process of combustion the air is contaminated with certain poisonous compounds, such as

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carbonic acid, carbonic oxide, and sulphur, which, when breathed even in a limited quantity, are injurious to the human frame. Another effect of combustion is the production of vapour, formed by the oxygen of the air combining with the hydrogen, which constitutes a portion of the material consumed. The presence of this vapour will readily be detected if a decanter of cold or iced water is brought into a room where a number of lights are burning. The surface of the decanter will be speedily covered with a thick dew, caused by the vapor floating in the air being condensed by the action of the cold water within.

As we all desire to live in pure air, is it not strange that we should be content to use a light which not only robs the atmosphere of oxygen, thus destroying its life-supporting virtue, but actually loads it with noxious vapours, the products of combustion?

Considering the comparative merits of the various artificial lights now in use, the following table from Dr. Tidy's "Handbook of Modern Chemistry" will afford some idea of the heat-producing and air-vitiating effects of the different bodies enumerated. To this table Mr. R. Hammond has added the effects produced by a 12-candle incandescent electric lamp.

TABLE—Showing the oxygen consumed, the carbonic acid produced, and the air vitiated, by the combustion of certain bodies burnt so as to give the light of 12 standard sperm candles, each candle burning at the rate of 120 grains per hour:—

Burnt to give light of 12 candles, equal to 120 grains per hour.	Cubic feet of oxygen consumed.	Cubic feet of air consumed	Cubic feet of carbonic acid produced.	Cubic feet of air vitiated.	Heat produced in lbs. of water raised 10° F
Cannel Gas.....	3·30	16·50	2·01	217·50	195·0
Common Gas	5·45	17·25	3·21	348·25	278·6
Sperm Oil	4·75	23·75	3·33	356·75	233·5
Benzole	4·46	22·30	3·54	376·30	232·6
Paraffin	6·81	34·05	4·50	484·05	361·9
Camphine	6·65	33·25	4·77	510·25	325·1
Sperm Candles ..	7·57	37·85	5·77	614·85	351·7
Wax	8·41	42·05	5·90	632·25	383·1
Stearic.....	8·82	44·10	6·25	669·10	374·7
Tallow.....	12·00	60·00	8·73	933·00	505·4
Electric Light....	none	none	none	none	13·8

From this table it follows that an ordinary gas burner consuming 5 cubic feet per hour absorbs nearly 5½ cubic feet of

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oxygen per hour, or, in other words, it deprives 17 cubic feet of air of its oxygen in an hour. But, as has been already pointed out, gas not only deprives the air of its health-giving oxygen, but it contaminates it with poisonous compounds which are more or less—according to the extent to which they exist—injurious to animal life. Dr. Tidy considers that the contamination of the atmosphere in a crowded theatre at the end of the performance may be regarded as distressing; and many of us experience a disinclination to go to the theatre because of the inconvenience suffered from the heat and vitiation of the air caused by the gas, producing headache and oftentimes, giddiness. The effects of heat and vapour from combustion will be readily detected in a wareroom or shop, the lower portion of which may be only at a temperature of 60° to 70°, in consequence of the hot-air ascending, the temperature near the ceiling will probably be from 130° to 140°. When, therefore, goods, books, &c., are placed in such high localities it cannot be wondered at that they become injured or destroyed. Indeed, referring to the amount of water generated by the gas flame, it is stated on authority that sixty gas jets will produce on the lowest computation two gallons of water per hour! Thus it is we often see on a December evening streams of water trickling down the windows of shops brilliantly lighted by gas.

Turning to the table above quoted, we find that electric lighting by incandescence produces absolutely none of the evil effects just enumerated. There is no oxygen consumed, no carbonic acid or other compounds given off, and, consequently, there is no vitiation whatever of the atmosphere; and, as to the heat-producing effects, the table shows that the air of a room lighted by gas is twenty times more heated than if lighted by incandescent electric lamps. From this it will be readily seen how conducive to health and bodily comfort are the conditions fulfilled by electric light in contrast with all other illuminants. And not only is the health and bodily comfort affected by the influence of artificial light, but the temperament also; and it is very remarkable to notice the difference in the effect produced by gas light, and electric light, on the spirits of those obliged to work long hours at night. A brilliant light, we all know, exercises a cheerful influence on the animal spirits, and electric lighting affords unusual facilities for acquiring a higher degree of illumination without the accompanying heating and air-vitiating evils inseparable from gas and petroleum.

It has been said, as an argument against the use of electric light, that it is injurious to the eyesight, and, therefore, cannot be considered as conducive to health. This argument is more imaginary than real, and has no foundation in fact. As

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compared with other lights, electric light is less injurious, when used under proper conditions. True, an unsteady or flickering light has an ill effect on the sight, and electric lighting on the *arc* system is open to this objection, a defect which, however, will, doubtless, be remedied in time. But the *incandescent* system leaves nothing to be desired. The light is pure, soft, and white, and is absolutely steady in its action.

It is this system which concerns us at present, since it is the most suitable for indoor purposes, and consequently bears directly on the question of health.

The flame of a candle, or a gas flame, is not absolutely steady, although considerable improvements have been made in gas-lighting, during recent years, by the introduction of better burners and more suitable globes; but in some cases—for instance, in factories—globes cannot be conveniently used, and the flame is ever subject to drafts, causing a disagreeable wavering or flickering in the light. It is impossible that the light of the incandescent electric lamp can be affected in this way.

The glare of the electric light is also commented on as being objectionable; but this is only applicable to the arc light, and even this form readily admits of being shielded in ground globes; and as it is only suitable for outdoor use and for large buildings, it is not necessary here to say much about it. It might, however, be said *en passant* that we have no right to stare at the electric arc any more than we have to stare at the sun, which makes our eyes weak, and otherwise inconveniences us. A strange story was told in the newspapers a few days ago, of a boy, aged about 14 years, who, for a wager, stared at the sun for some time, and died the same night in great agony. Professor Pickering, a German *savant*, recently made an investigation into the cause of weak sight amongst the students of his university, and traced it to the heat given off by their reading lamps, which dried up the humours of the eye. Seeing that the electric light gives off but a trifling degree of heat it is, therefore, far preferable in this respect, and far less injurious to the sight than gas, oil, or candle light.

Many institutions throughout the country are now lighted by electricity, and in every single instance with the most beneficial results to the health and comfort of the people who work by its aid.

It would be impossible in a small space to describe the lighting arrangements in these institutions, but the author may be permitted to refer to one installation which has been working under his charge for the past nine months, and which will serve as an illustration for many others. The installation referred to is that of the offices of the *Irish Times*. The composing

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room here forms one large apartment measuring some 60 by 40 by 70 feet in height. Before the introduction of the electric light, this apartment was lighted by 100 gas jets, and, remembering that one gas jet consumes as much oxygen as five individuals, and adding to this the effects resulting from the breathing of the compositors, together with the long hours of night during which the work is carried on, we can readily conceive how extremely unwholesome and unhealthy must have been the air of this apartment. Indeed, as a matter of fact, the employés frequently suffered from ill health and discomfort, which they usually attributed to the vitiated state of the atmosphere, and it was not unusual to have several out on sick leave at one time. This was especially noticeable in summer. The temperature of the apartment frequently ran as high as 85° in winter, and 95° in summer. The discomfort occasioned sometimes in summer was very serious indeed, oftentimes rendering it impossible for some of the men to carry on their business for the usual number of working hours.

Since the introduction of the electric light the condition of things is entirely changed. The atmosphere is pure and healthy, the thermometer rarely marks higher than 70° during the night, the light is bright and perfectly steady in its action, the health of the employés good, and their spirits cheerful and buoyant, many of them being able to work for considerably longer hours now than formerly, and the sick list has all but disappeared.

This proves that not only from a sanitary, but also from a *commercial* point of view is the introduction of the electric light beneficial.

It may be argued that a proper system of ventilation would render the use of gas harmless; but the question of ventilation, although apparently so simple, is difficult to deal with. Sometimes arrangements adopted to ensure a good supply of fresh air may be admirable in calm or warm weather, and just the opposite in cold or boisterous weather. Again, a means of ventilation may work well for a period, and, unexpectedly, perhaps, owing to a change in the wind, instead of the noxious products of combustion passing off, the wind rushes in with occasional gusts causing the flame to become agitated and smoky and the air is vitiated to even a greater extent than otherwise. With the electric light the difficulty of ventilation is reduced to a minimum.

Amongst other advantages of the electric light, which, although not strictly relating to its sanitary aspect, have, nevertheless, an indirect effect on health, may be mentioned the following:—Plants grow in rooms lighted by it, and cut flowers exhibit their true colours, and do not quickly wither; paintings show

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their natural tints and colours to better advantage. Its influence on the health of children is incalculable. An electrically-lighted nursery, even if the light remains on all night long, is free from the noxious vapours produced by candles or gas. The electric light also lends itself to artistic treatment in the most admirable way.

In the adoption of the electric light, therefore, we fulfil the following important considerations:—We do not deprive the air of oxygen, so necessary for our health and comfort; we do not adulterate the air with pernicious compounds of any kind; we avoid the accumulation of vapour; only a small degree of heat is produced; and we facilitate the means of ventilation.

In fact, by means of electricity we have at last obtained an artificial light, which is nearly all that could be desired; and, regarded from a sanitary point of view alone, its development and introduction should command our warmest sympathy and earnest support.

It may be expected that some reference might be made here concerning the expense of the electric light, but since the subject has been dealt with chiefly from a sanitary point of view, and as the question of first cost and maintenance involves considerations which could scarcely be fairly treated in a paper of this kind, the author may be excused for not entering into details or comparisons of cost.

So long as electric lighting is carried on in isolated installations, it will be found difficult, no doubt, to compete with its older rival, although there are cases where the cost of such installations compares favourably with gas. The expense of maintenance by isolated lighting is governed entirely by local considerations. Where the light is required only to a limited extent—say 100 incandescent lamps burning for less than 1,000 hours per annum—the cost will probably exceed that of gas; but where the number of lamps reaches 200 and the number of working hours amounts to about 2,000 per year, then electricity will undoubtedly beat gas. It is, however, unfair to compare the expense of lighting by isolated installations with that of lighting by means of a well-established and elaborate system, whose existence is founded on the experience of half a century. However, in considering the question of expense, the superior advantages which we have endeavoured to point out, inherent in the electric system should entitle it to a higher price than all other systems of artificial illumination.

The time will come, however, when the electric current will be supplied on a large and comprehensive scale, and when its merits will be fully appreciated by all; then the question of cost will no longer form an insuperable barrier to its universal adoption.

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Sir ROBERT RAWLINSON, C.B. (President of the Congress), said that two important questions were its certainty in use and its economy. With regard to the former question, the electric light had on repeated occasions gone out suddenly. There was a field for it in special purposes, but it was not nearly so cheap as gas, and it would be very difficult indeed for electricity to compete with gas.

A discussion followed, and

Mr. J. ANGELO FAHIE, in reply, said that no doubt there were still some difficulties which impeded the successful and economical application of the electric light, but it should be remembered that difficulties had always to be overcome in the introduction of every new industry, and those attending electric lighting were being removed from time to time, as electricians gained experience by actual practical work. As to the accident which occurred at the Health Exhibition, it simply arose from the attendant incautiously placing both his hands at one time on or in connection with the opposite brushes of the dynamo, thus receiving through his body the current which was being generated to feed some 23 arc lamps. It appears that the unhappy man had been cautioned against placing both hands on the machine, and the accident was wholly due to negligence.

During the reading of the paper, Mr. Fahie exhibited a specimen of the spectacles or goggles recently devised by Dr. W. H. Stone, for the use of electrical engineers and others connected with electric lighting. These goggles have blue glasses in the front, and are provided with side glasses tinted red. When looking at the incandescent light the blue glasses are used, and the red rays neutralized; while for the purpose of examining the arc light the red side glasses are turned down and both are used, by which means any danger to the eye arising from excess of blue rays is obviated.

On "Temporary Hospitals," by HOWARD PENTLAND, B.A.

THERE are two main classes of temporary hospitals—

I. Those that are built on the path of an epidemic.

II. Those that are built in the belief that permanent hospitals are a mistake.

The first may be suitably termed isolation hospitals, as in them it is proposed to isolate the patients from the public and if possible from one another.

As a general rule they bear the marks of hasty consideration,

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and in no case show an advance proportional to that of permanent hospitals; whilst their remoteness has often entailed great inconvenience. These two evils may be eliminated if we apply to them the principles that guide us in the design of permanent hospitals, and adopt some means of rendering their nearness comparatively harmless.

Several materials offer themselves—

1. Galvanized corrugated iron.
2. Wood.
3. Tiles.
4. Slates.
5. Concrete.
6. Felt.
7. Willesden paper.

The first, used by itself on a framework of iron, or even wood, though proof against infectious matter, is too good a conductor; and the second, as well as being the inverse, is too liable to decay, considering its price.

A construction in the form of external iron sheeting and internal wood sheeting is an improvement, but with Willesden paper lining would be better still.

Slates and tiles nailed to boarding or battens on framing, and lined with wood sheeting, are more permanent than the last, but not so clean or so easily ventilated in the framing space.

Concrete or cement is not suitable, except in the form given to it by Mr. Lascelles, which consists of thin slabs screwed to wooden framing. It is good, but cemented to concrete framing as supplied by Mr. Lascelles, it seems less liable to infection. It may be lined with thinner slabs if desired. Concrete, however, in either form, or wood lined iron is, on account of its comparative expense, more suitable for hospitals of Class II, than for the cheap temporary buildings of Class I. Plastering may of course be used, but it should be executed on corrugated wire netting and not on laths.

Felt and paper remain.

The former requires wood sheeting for a foundation, whereas the latter does not, and, moreover, is capable of harbouring vermin and infection to a large extent.

Willesden Paper would, therefore, seem to be the best material for "Temporary Isolation Hospitals." It is an extremely bad conductor, has a very hard, smooth surface, and considerable strength.

Willesden Paper is much less combustible than either wood or felt, and burns with difficulty.

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Taking the framing as constant in value, these materials are worth per square foot laid—

Galvanized Corrugated Iron	6d.
Wood Sheeting	4d.
Tiles	7d.
Slates	5½d.
Concrete Slabs (external)	6d.
" " (internal)	4½d.
Willesden Paper	2½d.

The cost, then, of the various coverings, exclusive of the framing, is as follows:—

Tiles lined with wood sheeting	11d.
Slates " " "	9½d.
Concrete slabs, externally and internally ...	10½d.
Galvanized iron, lined with wood sheeting ...	10d.
Galvanized iron lined with Willesden paper...	8½d.
Willesden paper alone...	2½d.

Willesden paper is, therefore, the cheapest, as well as being otherwise the most suitable for "Isolation Hospitals" for epidemics.

The Health Committee of the Corporation of Liverpool have just used a large quantity of this paper in the construction of hospital huts.

The next question is as to the best form.

All authorities are agreed that whatever disadvantages some of the details of the Tollet System in permanent hospitals may entail, that its intrinsic merit lies in its providing an open basement.

This, which is a difficult and expensive requisition as advocated by M. Tollet, is almost a necessity in a timber structure.

The whole concern could be carried on a few timber or H iron posts, planted in lumps of concrete or driven as piles. Underground air would thus be eliminated at once. So far we follow M. Tollet, but from this point we must borrow Burdon Sanderson's idea of annular wards as proposed in his evidence on the "Small-pox and Fever Hospitals'" Commission, and Dr. Richardson's idea of the wholesale disinfection of hospital air, as proposed in a paper in Vol. III. of the Transactions of this Institute.

If these buildings are to be in a populous district they must at least be rendered as harmless as an ordinary hospital, and this can only be done by a whole or partial application of Dr. Richardson's idea. This again cannot be practically realized, except in an annular ward, where air is drawn from the external circumference through the ring, and the internal circumference into the inner circle, and upwards and outwards through a disinfecting aspirator, such as a brazier of glowing pumice, or a

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hot ring of bunsen burners, in connection with a spiral drain ventilator, charged with sulphurous acid.

Curves, again, cannot be very easily realized in timber, so we must replace the circle by a convenient polygon, which may be sub-divided to any extent desired. The accompanying diagram shows an attempted solution of the problem for four patients.

Many nurses might be required for four cholera patients, but one for every two patients is the maximum which should sleep in the Isolation Hospital, the others being accommodated in an isolated administration building, or in the main hospital, according as the Isolated Hospital was an independent institution or an offshoot.

A verandah runs round the whole to afford dry intercommunication, each room having a protecting porch.

The foul air is all concentrated in a central chamber approached from beneath, where the heating, ventilating, and disinfecting apparatus is placed. But the nurses' rooms have no openings to this, their ventilation being effected in the usual manner by a window; a sheet iron diaphragm protects the stoker from the foul air; an airtight pane in both partitions enables the nurse to view her two patients. The heating could be effected either by a stove in each room (stoked from the centre) and all gathered to the central shaft, or more expensively by a central stove, and a coil of hot water pipes with a stop-cock, placed similarly to the stove, or else to warm the incoming air. Such a building, which could accommodate six patients on an emergency, would cost about £160, including heating and ventilating, and would, with slight repairs, last 20 years in thorough efficiency and much longer with partial renewals.

As the wall space of each room on the central chamber must have an inferior limit, and as the area of a regular polygon increases more quickly than its periphery, there is a superior limit to the number of patients that can be accommodated in one such Isolation Hospital. This number may be easily calculated for a particular case.

A=working area per room required in central chamber.
l=convenient wall space on central chamber per room.
n=number of patients.
r=ratio of nurses to patients.

$$An\,(1+r) = \frac{l^2}{4}\,n\,(1+r)\cot\frac{\pi}{n\,(1+r)}$$

$$\text{whence } n = \frac{1}{1+r}\cdot\frac{\pi}{\tan^{-1}\frac{l^2}{4A}}$$

for the values 11, 5, 4, $\frac{1}{2}$. n=4 which with two nurses may be accommodated in a hexagonal hospital.

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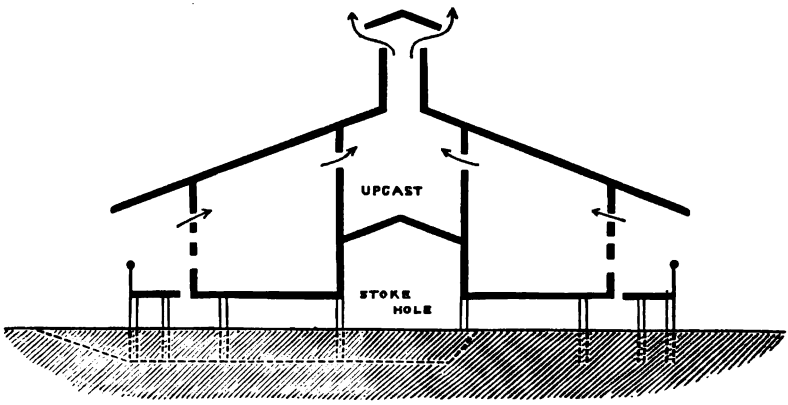

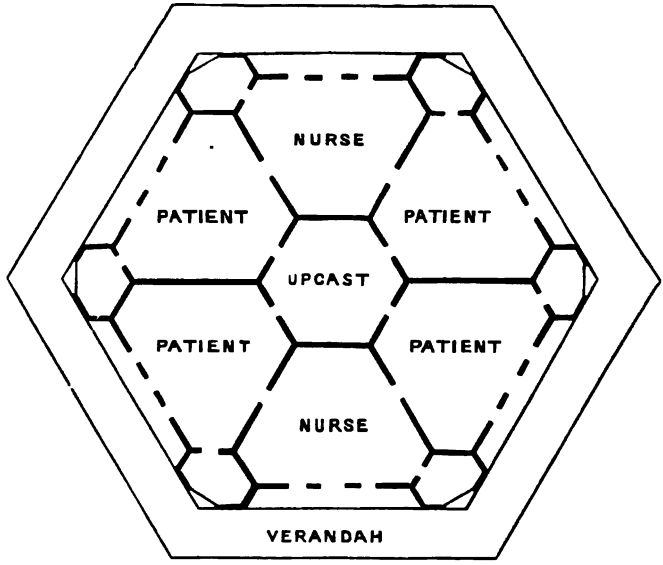

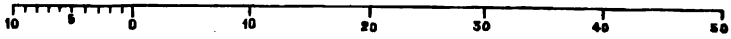

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In the most advanced types of modern hospital construction, it is now usual to isolate the wards from one another and the administration. A large hospital might thus be laid out, consisting of a number of these polygonal units, disposed round a central administration, and connected thereto and to one another by a light tramway or passage under cover, and telephones. Were single wards dispensed with the cost would be proportionately reduced; but a shilling per week per bed is all that need ever be spent to provide efficient hospital accommodation for any class of patients.

Class II. brings us face to face with the hospital of the future. What this may be it seems hard to predict, but in view of the radical changes in hospital construction during the last fifty years, it will at least be admitted that another generation will see still further changes.

From the time that Erichsen first drew attention to the evils of "hospitalism" down to the present, when most of us accept Pasteur's theories as gospel, there has been a gradual series of attempts to eliminate infectious matter and infection holding matter from the vicinity of the patients, and the last to be removed will possibly be the hospital itself. But as the hospital itself, like air, is a constant necessity, the operation could only be performed periodically.

The period, which is known for air, is unfortunately not known for wood, concrete, plaster, paper, &c., but must sooner or later be determined. This belief, which is gaining ground, especially in Germany, points to the desirability of structures more of the nature of the Moabite Barrack Hospital in Berlin than of the new St. Thomas's Hospital in London. M. Tollet, whose expensive buildings are mostly constructed of concrete and iron, points to the fact that concrete walls, finished with a smooth painted surface, are virtually incapable of germ absorption, and can, moreover, be periodically flushed with flame, or hosed with antiseptic solutions.

But we are not as yet in a position to ascertain that any building material, except perhaps iron, is so non-absorbent of infectious matter.

Economy, too, favours the erection of hospitals that will last only for a short period. When the capitalization of the interest of the sums expended on permanent hospitals, and their repairs is taken into account, it will be found that hospitals of a cheap construction, such as that of the Moabite Barrack Hospital, or buildings of galvanized iron, lined with Willesden paper, have the advantage. A change of site which is often desirable, but impossible, could be easily effected when desired.

Hygiene and economy thus point to the erection of cheap

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polygonal hospitals of one story, well raised from the ground on posts, destroyed after one generation's use, and transferred elsewhere for the next. The principle also relieves us from the necessity of providing for posterity.

These are strong arguments, but undoubtedly the strongest against costly permanent hospitals is the undoubted fact that in half a century ours will be thought of as we now think of the old Hôtel Dieu in Paris.

Should Portland cement concrete slabs prove to be tolerably non-retentive of infectious matter, Lascelles' construction seems the best of those mentioned, but otherwise galvanised iron buildings lined with Willesden paper, which could have their linings burnt and renewed, and the iron flamed every few years, would prevail in Class II.

In this class of hospital a greater number than six in each polygon should probably be attempted, but for large numbers, with a central administration and schools, the general scheme should be identical with that mentioned for Class I.

It is for the public to choose whether they will exercise their benevolence in this manner, which *caeteris paribus* would afford more relief than the present system, or in raising monuments which, however in accordance with the most advanced scientific views, may yet, for aught we know, propagate disease, and will most assuredly be despised by posterity.

Sir Robert Rawlinson, C.B. (the President of the Congress), said this was one of the best papers he had listened to, and he wished the promoters the best possible success. All his sympathies were with cheap temporary hospitals. Here was a proposal by which a man could have restoration to health in a hospital where the cost would only be 1s. each bed per week.

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SECTION III.

CHEMISTRY, METEOROLOGY AND GEOLOGY.

ADDRESS

By Charles A. Cameron, F.R.C.S.I., C.S.S.Camb.

PRESIDENT OF THE SECTION.

That abnormal food is a factor in the production of disease and death in man is a fact acknowledged from time immemorial. The divinely inspired laws promulgated by Moses, direct that the flesh of animals that have died from disease shall not be used as food. They also prohibit the use of blood as food—a remarkable prohibition, when it is considered that it is chiefly in the blood that the virus of so many dangerous diseases circulates. The writers of the Babylonian Talmud make frequent references to the subject of diseased food, and clearly recognize the difference between the flesh of an animal affected with a specific disease, and that of an animal injured by purely accidental causes.

It is only within a very recent period that the particular causes which render both animal and vegetable food unwholesome or actually poisonous have been scientifically investigated. The information gained, though a substantial addition to our knowledge of the ætiology of disease, is still, in many respects, very imperfect. The further elucidation of this interesting subject offers a wide field of enquiry to the microscopist, the chemist, the pathologist, and the biologist.

For the purposes of this address I shall arrange diseased and otherwise unsound food into five classes:—

1st. Vegetable food infested by fungi and other parasities, chiefly miscroscopic.

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2nd. Animal food containing entozoa, or internal parasities.

3rd. Animal food containing micro-organisms endowed with virulent properties.

4th. Animal and vegetable foods containing alkaloids generated during putrefaction.

5th. The flesh of animals affected by specific diseases, the various *materies morbi* of which have not been isolated.

Poisonous Moulds.

Ergot, a disease affecting the seeds of the grasses, and especially of rye, is caused by a minute organism, placed by Link and Berkeley amongst the species of fungi included in the genus *Oidium*. The ergotized grain is very dark, sometimes quite black. These fungi in large doses are poisonous. They cause gangrene of various parts of the body, and even sloughing off of the extremities has been occasioned by them. Some years ago I found that the grasses in a large field near Navan, county of Meath, were peculiarly affected with ergot. The animals that grazed in the field lost their horns and hoofs. Many localized epidemics of gangrenous disease have been caused by the use of ergotized grain.

The genus Oidium includes a species which has often almost annihilated the wine crops of France and other countries.

The moulds, or minute fungi which are developed in bread and other vegetable foods are occasionally poisonous. Five species of moulds have been observed on bread, namely, Mucor mucedo, Penicillium glaucum, Aspergillus glaucus, Ascophora nigricans, and Oidium aurantiacum. Of these M. Mégnin considers the last named the most poisonous.* This author cites cases showing the poisonous qualities of mouldy bread.

In Sheffield in 1879 eight persons were poisoned by eating puddings chiefly prepared in an "eating house" from bread crusts, the accumulation of weeks, and which undoubtedly must have been mouldy. Two of the affected persons died. The scientific evidence produced at the inquests negatived the presence of ordinary poisons in the food. In the *Veterinarian* for May, 1878, I published an account of the deaths of a large number of sheep and oxen which I clearly proved to have been caused by eating mouldy food. In the *Dublin Journal of Medical Science* for February, 1879, I have recorded several cases of death and illness in man caused by mouldy food, which I had personally investigated.

The presence of fungi, and probably of algæ, in potable water,

* *Revue d'Hygiene*, Paris, 20th June, 1881.

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occasionally causes the latter to have poisonous properties. Dr. Holdefleiss, in Biedermann's "Centrallblatt" for 1879, insists strongly on the poisonous nature of water in which the colourless algæ occur.

It has been noticed that lake and pond waters often acquire a green colour, which passes away after a few days. This colour is generally due to the development of immense numbers of oscillaria, *Euglena Viridis*, &c. These coloured waters frequently are sufficiently toxic to kill all the fish in them. Some time ago I had a water of this kind, which on being preserved for some weeks in a glass vessel, passed from a green to a magnificent red hue. The change was caused by the oxidation of the chlorophyll formed by the algæ.

A specimen of bluish-green water, from Lough Derg on the Shannon, was sent to me for examination in June last. The coloured water rather suddenly appeared in a creek of the lake, and geese and ducks belonging to several persons were poisoned by drinking. In this case the colour appeared to be due not so much to algæ as to pigment forming micrococci. These were seen in great numbers, forming colonies or zooglœa. No doubt these micrococci were the poisonous principle of the water.

Parasitical Diseases of Animals.

The flesh of animals affected with parasitical disease is largely consumed. The pig is occasionally the home of the *Cysticercus cellulosus*. The presence of this parasite constitutes the disease termed *measles* in the pig, but which has no analogy whatever to the malady of the same name peculiar to man. The cysticerci cellulosæ are the immature condition of the tape worm (*Tænia solium*), a human entozoon, or internal parasite. In the sheep cysticerci are very rare, but I not unfrequently meet with them in the ox.

It is stated in many works on Hygiene that 2 per cent. of Irish pigs are infected with measle worms, but I have not found this to be the case during recent years at least. In fact I rarely meet with this disease in the pigs slaughtered in Dublin.

The tænia forming parasites are destroyed by the thorough cooking of the meat in which they occur.

The "sturdy" of sheep is caused by the presence of a bladder worm (*Cœnuris cerebralis*) in the animal's brain; and the rot in the same animal and the ox results from the presence of very large entozoa (*Distomæ hepaticæ*), popularly termed "flukes," in the liver. Unless the flesh of the affected animals be sensibly deteriorated I think these diseases do not necessarily render the flesh of the affected animals unfit for food.

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The *Trichina spiralis* is a small worm found chiefly in the pig, less frequently in man, the cat, rat, mouse, badger, and some other animals. It occurs in two conditions, first as a worm moving about, barely visible to the naked eye, and second enclosed in cysts. The male is about two millimetres, and the female three millimetres, in length. It is said that a single worm will produce more than 1,000 eggs. The free trichinæ penetrate from the intestinal tract through the abdominal wall into the blood and muscles. In the latter they become after a while coiled up in cysts, which ultimately become more or less calcareous. In these cysts the trichinæ retain for a very long period their vitality. When a portion of the muscle of, say a pig, containing trichinæ is swallowed by another animal, the gastric juices dissolve the cysts, and liberate the imprisoned worms. The migrations of these tiny worms from the digestive canal to the most remote parts of the body occasion severe pain, and probably the symptoms have often been mistaken for rheumatic fever. The presence in sufficient numbers of the trichinæ constitutes the disease termed *trichinosis*—a malady by no means uncommon. In Germany outbreaks of trichinosis are frequent, owing to the practice of eating pork, hams, bacon, and sausages almost or altogether raw.

The most recent of the more serious outbreaks of trichinosis is that recorded by Dr. Joesting, of Halberstadt, in the December number of the *Centralblatt für Allgemeine Gesund Neitspflege*. The flesh of a pig infested with trichinæ was eaten in a raw or smoked state by some of the inhabitants of the little town of Emersleben, on the 18th September, 1883. Three days after the slaughter of the pig, all the members of the family of the butcher who killed the animal began to suffer from diarrhœa and other symptoms of the same nature. Soon other cases followed, and up to the 11th of November, 361 cases of illness occurred in Emersleben and its neighbourhood, all the patients having consumed portions of the pig. The mortality was high, fifty-seven of the cases proving fatal. In the bodies of the deceased, trichinæ in great numbers were detected.

Trichinæ in their free state are easily destroyed by heat, but in their encysted condition they resist the action of heat for a longer time. The ova of the parasite are difficult to destroy. It is, therefore, advisable to boil pork, ham, bacon, and sausages much more thoroughly than is usually the case if we desire to secure immunity against invasions of trichinæ spiralis.

The Guinea worms (*Filaria Medinensis*) are very long and slender worms, which cause severe cutaneous abscesses. They pass from small crustaceans into water, which, when swallowed

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by man, introduces the worms into the stomach. These worms are only found in certain tropical countries.*

Dr. Spencer Cobbold, an eminent authority on the entozoa, states that a common mode of the entry of parasites into the human body is in salads and other raw vegetables, eaten without having been perfectly washed. Unfiltered water often contains parasites and their ova.

Micro-organisms.

Many of the diseases affecting man and the lower animals are caused by very minute organisms, which multiply in the blood and tissues. They are termed micro-organisms, because they are not visible to the unassisted eye. Some of these objects are so minute that 50,000 of them only equal in bulk a cheese-mite.

Air, earth, and water, teem with micro-organisms. They are found on our furniture, clothing, food, and bodies. The immense majority are harmless, some are virulent. Some of these micro-organisms are the ova of minute animals, but the greater number are fungi.

A mushroom is a fungus, and, like all of its kind, subsists upon organised matter, and not, as other kinds of plants do, upon carbonic acid gas, water, ammonia, and other mineral substances. Some of the microscopic mushrooms resemble animals in having locomotive powers, and in requiring free oxygen; hence it has been contended that they are animals. These organisms are not only on the confines of the visible world, but they are also on the borderland which divides the two great organic kingdoms of nature—the animal and the vegetable. A chain, each link of which is somewhat differently fashioned, passes through each of these kingdoms; it may be that these micro-organisms are the links by which these chains are united and made continuous throughout the animated world.

The micro-organisms occurring in animals and vegetables which I propose to consider in connection with the subject of fermentation and disease, are almost universally regarded as fungi or moulds. They can generally be examined by means of a microscope capable of magnifying about 400 diameters linear. They occur in flesh, blood, organic liquids—such as broth—water, &c. They are more readily identified in muscle, &c., by treating the latter with solution of some aniline dye. The

* Dr. Thudichum's admirable monograph on the parasite diseases of animals used as food, furnished as a supplement to one of the Reports of the Medical Officer of the Privy Council should be read by all who are interested in the subject.

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micro-organism acquires the colour of the dye, whilst the muscular tissue remains unstained. Ether, and acid and alkaline solutions, which dissolve or alter the form of pus and fat corpuscles and other microscopic objects likely to be mistaken for micro-organisms, have no effect upon the latter.

Classification of Micro-organisms.

Cohn arranges these micro-organisms according to their forms into the following groups:—Sphærobacteria (having globular or oval shapes), microbacteria (very minute rod-shaped cells), desmobacteria (long and comparatively large rod-like cells), and spirobacteria (spiral cells). It is clear, then, Cohn includes all these organisms under the general term—bacterium. They have, however, a very extensive nomenclature, and the term bacterium is now generally restricted to short cylindrical organisms. The simple round or oval cell is termed micrococcus, those with a ribbon-shape, bacilli and the spiral-shaped are divided into two groups—spirochus and spirillum. The micro-organisms, which are supposed to cause disease, chemical changes, &c., have names given to them which I shall mention farther on.

Micrococci.

The chemical composition of micrococci, &c., is peculiar. Unlike plants in general, they contain very little cellulose or starch. Their albuminous constituent is, according to Von Nencki, a peculiar body, which he has named mycroprotein. The thin cellulose covering of the cells is readily shewn by treatment with dilute sulphuric acid and iodine, which develops a blue hue. Most species of micrococci are very minute, but one kind, *micrococcus prodigiosus*, which sometimes colours snow red, consists of comparatively large cells. In liquid and tissue the micrococci are met with, in strings like beads, isolated, in the shape of dumb-bells, and in masses (*Zooglœa*), cemented by a gelatinous substance; they multiply by division, and it has been computed that a single micrococcus may, within twenty-four hours, produce more than sixteen millions of its kind!

The micrococci are not the most harmless of the micro-organisms. They have been found in connection with pneumonia, diphtheria, endocartitis, scarlet fever, puerperal fever, vaccinia, small-pox, and erysipelas in man, and in the cattle plague and bovine pleuro-pneumonia. The causal connection of micrococci with any one of these maladies has not been as yet conclusively proved, except perhaps in the case of erysipelas. That some species are virulent has, however, been clearly shewn by Friedlander and Frobenius and others.

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According to Dr. Frank Ogston, of Aberdeen, inflammation is, except in cases of such injuries as burns, always caused by micrococci.

The powerful chemical action of micrococci has been placed beyond all doubt. The phosphorescence of fish and the production of mucus in wine have been traced to their agency. They have wonderful powers in forming pigments provided they have free access of air.

The septic micrococci are very numerous; they are found in all kinds of putrefying organic matters: I always meet with them in foul water.

The disease termed *pébrine* affecting silk worms is caused by a species of micrococcus. Pasteur has suggested a successful method of protecting the worm against the ravages of this pest.

Bacteria.

The bacteria of Cohn may be regarded as slightly more organised than the micrococci. They occur as cylindrical rods or oval cells. They seldom form chains, but are found in colonies (*Zooglæa*). Having a flagellum at one or both ends they have motile power, and their movements are very lively. They multiply by division. They are often so numerous in infusions that they form a thick pellicle or scum.

The *Bacterium termo* is found in putrefying organic matter. There is every reason to believe that bacteria are the cause of the decomposition. A large species—*Bacterium lineola*—occurs in water and in various organic infusions. The movements of these bacteria are rapid.

The bacterium termo probably plays a useful part in the economy of nature. It causes a gradual and innocuous retrograde metamorphosis of organic matter, resulting in its reduction to water, carbonic acid, ammonia, and nitrates—the inorganic food of plants.

A bacterium in milk transforms its sugar (lactin) into lactic acid. Another, *Mycoderma aceti*, is the cause, according to Pasteur and Cohn, of the acetic acid formation. Several pigments are developed by them. The disease affecting the domestic fowl, and termed fowl cholera, is declared by Semmer, Toussaint, and Pasteur to be due to the presence of a species of bacterium in the blood and tissues of those animals. Davaine and Koch have induced septicæmia, or blood poisoning, in animals by innoculating them with bacteria derived from decomposing organic matter.

The term *Microbes* is sometimes applied to the bacteria and other minute organisms alleged to cause disease.

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The Bacilli.

We now come to perhaps the most formidable of the micro-organisms—the Bacilli. They are cylindrical, rounded or square at their extremities, and many have flagella which enable them to move about. Some of the rods, or strings rather, are of great length; they are termed leptothrix. Unlike the micrococci they form spores. They also multiply by transverse division.

A species of bacillus causes the rancidity of butter by producing butyric acid, but it discharges a useful part in the ripening of cheese. Upon cellulose, a substance not readily amenable to chemical solvents, it exercises a potent influence, causing it to break up and become soluble in the digestive fluids of the stomachs of the ruminants. This bacillus may, with almost absolute certainty, be found in the stomachs of these animals.

The hay bacillus (*Bacillus subtilis*) consists of rods of from 0·002 to 0·006 millimetre in length, and from 0·002 to 0·003 millimetre in thickness. They combine to form rods or filaments, some of which are of great length. They form spores about one-half the size of a bacillus, but the spores are not stained or affected by dyes. Although this organism is called the hay bacillus, it is almost invariably to be met with in all decomposing nitrogenous organic matters.

Several non-motile species (*Bacillus Septicus*) are found in putrid blood and other albuminous matters. I have seen them in sediments from water. They can exist without air. They occur occasionally in the bodies of dead animals.

The term *pathogenic bacilli* has been applied to certain species which are believed to be the cause of specific diseases in man and the lower animals, or which at least must be admitted to be in some way intimately associated with the disease.

Koch, of Berlin, has discovered a bacillus in the bodies of persons who had died from Asiatic cholera, and in pond water tainted by choleraic egesta, a comma-shaped bacillus, which he believes to be the actual cause of the disease. The bacilli were compared with other bacilli found in the intestinal tracts of persons who had died from dysentery and other diseases affecting the alimentary canal, but they were quite different from the cholera bacilli. The latter are possessed of locomotive power, and they are capable of reproducing themselves outside the human body.

All attempts to induce cholera in the lower animals by introducing the comma-shaped bacilli into their systems failed, but it has long been known that this disease is not met with in the lower animals. Two important observations were made by

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Koch, namely, that the comma-bacillus, or cholera microbe, is easily killed by dessication, and that weak acid solutions, which have no appreciable effect upon other kinds of bacilli, greatly retard the development of the cholera microbe. It might therefore be advisable, should cholera invade these countries, to make vinegar or lemon-juice a constituent of every meal. Koch's theory of the causation of cholera has not as yet been universally accepted, but it cannot be shown to be untrue by other than experimental proofs.

Dr. T. R. Lewis, of Netley, has quite recently announced (*The Lancet*, September 20th, 1884) that he has discovered in the mouths and fauces of healthy persons comma-shaped bacilli which re-acted with dyes exactly like Koch's bacillus. He has not, however, shown that they behave identically under cultivation, but his observation is an important one.

The conditions affecting the life history of the cholera bacillus, favour the theory that cholera is spread by means of polluted water. We have it on the high authority of Surgeon-General De Renzy* that in India impure water is the principal vehicle in which the poison of this dreadful malady is spread. Dr. C. Macnamara, in his excellent work on cholera, refers to the presence of vibriones in immense numbers in water known to contain the *materies morbi* of cholera. In 1866 I examined the water supply on board the ship "Olive," lying in the River Liffey. I found that it teemed with micro-organisms, and that it was enormously polluted. An outbreak of cholera had taken place on board the vessel, due no doubt to the bad quality of the water used by the crew. There is, in short, an extensive literature relating to outbreaks of Asiatic cholera, ascribed to the use of infected water. Should the disease invade Dublin next year, we shall certainly be in a good condition to oppose its progress so far as a pure and abundant water supply constitutes a defensive armour. I fear, however, that this kind of armour is wanting in the great majority of Irish towns.

According to Pasteur, a micro-organism is the cause of hydrophobia. He is now engaged in the investigation of this microbe, and hopes to be able to "attenuate" its virus, so as to produce a hydrophobic vaccine, if I may use the term. Should he be successful we may hope for the extirpation of one of the most dreadful diseases to which man is liable.

Klebs and Tommasi-Crudelli, and Lanzi, and Terrigi assert that they have isolated the micro-organism of malarial fever.

According to Schütz and Löffler, Bouchard, Charvin, Wassilieff, and others, peculiar bacilli, resembling those of tubercle,

* Reports on the Sanitary Administration of the Punjâb for 1868 and 1869.

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are always found in connection with glanders. Animals inoculated with them have contracted the disease.*

Several observers claim to have discovered peculiar microbes in connection with typhoid fever. In the biological department of the Health Exhibition, now going on at South Kensington, a small oval bacillus, supposed to have some relation with typhoid fever, is shown under a microscope.

Neisser and Hanser have shown that minute bacilli are always to be found in the large cells in the nodules of leprous patients. They are less than 0·001 millimetre in thickness, and have pointed extremities.

That the terrible disease popularly known as consumption, and termed by pathologists tuberculosis, is contagious, seems now to be generally admitted. The cause of the disease is the introduction into the body of a species of *bacillus*, which Koch, its principal investigator, has termed *Bacillus tuberculosis*. It is pod-shaped, and about the same size as a blood corpuscle. It is almost always solitary, seldom occurring in pairs, and never in colonies. They have no motile power. They produce spores. These bacilli are met with in large numbers in the tubercles in the lungs of persons who have died from phthisis. The results of Koch's investigations have since the publication of his inquiries in 1882† been fully confirmed, and we must now place consumption amongst the contagious diseases. I may remark here that from early times there has been a popular belief in the infectiousness of this disease.

Knowing that the presence of a peculiar bacillus in the lungs indicates true tuberculosis, we may differentiate between tuberculosis and diseases which might for a while be mistaken for it by examining microscopically the patient's sputum, or matter ejected from the lungs in coughing. A little of the sputum is placed on the object-glass and rapidly dried over the gas or spirit-flame; the film is then soaked for fifteen minutes in a solution composed of 100 parts of a saturated water solution of aniline oil, and 12 parts of a 2 per cent. water solution of gentian blue. A mixture of 1 part of nitre and 2 of water is now applied for a second or two to the preparation; after which it is washed with distilled water. Finally, it is stained by immersion for fifteen minutes in a solution, of 1 gramme of Bismarck brown in 10 cubic centimetres of spirits of wine (specific gravity ·830) and 100 cubic centimetres of distilled water. The blue stains only the bacilli, and the brown only

* See *Deutsche Med. Wachenschrift*, 52, 1882, and 11, 1883, also *Revue Medicale Française*. Dec. 1882.

† *Berliner Klinische Wachenschrift*, No. 15, 10th April, 1882.

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the other substances, so that the contrast of colours makes it easy to identify the terrible micro-organism — the probable slayers of millions of mankind.

A characteristic bacillus has been found in the lungs of monkeys dead from phthisis, for these animals appear to resemble man in their diseases as well as in their anatomical structures. In the tubercles found in the lungs of the ox bacilli have also been detected. Koch has inoculated these and other kinds of animals with tubercular matter from man or the ox, and has found that the bacilli of the tubercle produced both bacilli and tubercle in the infected animal. Of course no one would try the experiment of inoculating man with the tubercle of the ox, but there is the strongest reason to believe that the terrible disease—tuberculosis in man—sometimes results from eating the flesh or drinking the milk from tuberculous cows. Dr. Charles Creighton, of Cambridge, in a remarkable work on "Bovine Tuberculosis in Man," published in 1881, stated that he believed an organism would yet be detected in tubercle—an organism which would probably have a family likeness to some other microbe organisms. Koch has detected the organism, and has shown that it is but one of the many varieties of the bacillus family. He has verified the theoretic assertion made long ago by Cohnheim, that tubercles only result from imported infection.

Klebs and Gerlach stated in 1868 that the milk of tuberculous cows was a common cause of tuberculosis in man, especially in children. Since then the question—Is tuberculosis transmissible to man through the media of meat and milk?—has been much discussed, the result being generally in the affirmative. Koch's contribution seems to me to have settled the matter, whether we hold with Schüppel that human and bovine tubercle are identical, or with Creighton that they are morphologically dissimilar, though man may become infected with tubercle from the ox.

Dairy cows are rather liable to tubercle. I always condemn the carcasses of animals affected with phthisis of a pronounced kind. The disease, popularly called the grapes, in cows, is tuberculosis. The membrane lining the great cavity of the animal is often almost completely covered with grape-like masses of tubercle. It requires very thorough cooking to destroy the bacillus of tubercle. Should there be any suspicion as to milk not being derived from a healthy animal, the safer plan is to boil it before using it.

The *Bacillis anthracis*, and closely allied species, occur in oxen affected with the so-called splenic fever, black-leg, or quarter evil, and the gloss anthrax; in sheep suffering from the

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carbuncular cynanche, the hæmorroidal anthrax, and the gangrenous erysipelas, and in the malignant boil of the pig. It is evident that the flesh of animals affected with such diseases should not be used as food for man.

Spiro bacteria.

I shall now briefly notice the vibriones and spirilla. One of the most interesting of the disease producing spirilla is that causing relapsing fever in man. It is called after its discoverer, *Spirillum Obermeyeri.* These organisms are minute wavy threads, which appear in great numbers in the blood during the paroxysms of the fever, and almost completely disappear when the fever subsides for the time. Relapsing fever is also termed "hunger" fever, as it often prevails during famines.

Several kinds of spirilla are found in putrefying substances, and no doubt exercise a septic action. The vibriones are also septic; they are curved rods, which exhibit rapid movements.

The coloured substances formed in paste, water, &c., are often caused by spirilla. One species is found in the tartar of teeth.

Metamorphosis of Micro-organisms.

Experiments have been made for the purpose of ascertaining —first, whether or not the artificial cultivation of harmless bacteria and micrococci might be so conducted as to render them pathogenic or disease-giving; and, second, whether or not the cultivation of pathogenic organisms might not be so managed as to moderate or destroy their virulence. As to the first of these attempts Hans Buchner asserts* that he converted the harmless hay bacillus into the deadly anthrax bacillus. According to this author it is not so much the original nature of the micro-organisms as that of the medium in which they are developed, which determines their pathogenic power. He cultivated the hay bacilius in defibrinated blood, maintained at a temperature of 36° cent., and found that after a few generations the descendents of the inoccuous bacteria acquired virulent properties. When introduced in small numbers into the blood of a healthy animal they appeared to cause its death, and the *post-mortem* appearances were similar to those of poisoning by anthrax bacilli.

Koch asserts that Buchner has not changed the nature of the hay bacillus. He points out that the material first used by Buchner for his cultivation was egg albumin which had not

* *Ueber die experimentelle Erzeugung des Milzbrandcontagiums aus den Heupilzen.*

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been sterilized, and which, therefore, might have contained the bacilli which give rise to malignant œdema. These micro-organisms are not uncommon in putrefying organic substances. They develop rapidly in the blood, in which liquid the hay bacillus languishes. Koch and also Klein, therefore, are of opinion that Buchner introduced into the blood both kinds of bacilli, and that the hay bacilli soon died out, whilst the other kind multiplied under conditions so favourable to their growth.

With respect to the conversion of baneful into innocuous or comparatively innocuous micro-organisms, Pasteur claims to have accomplished that triumph, so also do Buchner, Toussaint, Koch, and others.

The blood of animals affected with splenic fever invariably contains great numbers of bacilli. As this fever is termed malignant anthrax, these organisms have been termed *Bacilli anthracis*. They resemble hay bacilli, but they do not move about. They consist of rods which divide and elongate into straight or curved filaments. They produce spores. A single bacillus measures from 0·005 to 0·02 millimetre in length, and from 0·001 to 0·0013 in thickness. Dyes affect the bacilli but not their spores. The bacilli differ slightly in form in different animals. They can exist for a long time external to the bodies of animals, and are often present in pastures. The fatal malady affecting man termed Wool-sorters' disease is caused by the spores of the anthrax bacillus,—which are occasionally attached to wool or horse-hair,—making an entry into the body.

Cultivation of Microbes.

Pasteur asserts that by cultivating anthrax bacilli in chicken broth kept at a temperature of from 42° to 43° centigrade, they gradually lose their virulence. The bacilli which appear at the expiration of twenty days' of cultivation may be safely injected into the blood of sheep or oxen. The animals generally sicken slightly, but they afterwards appear to enjoy immunity from anthracoid diseases. Pasteur now prepares a vaccine (vaccin charbonneux) as a protective against splenic fever. It is largely sought for by the stock owners of France, and it is said that the demand exceeds the supply. By a similar process he moderates the virulence of the microbe which causes fowl, or chicken cholera.

Klein has made many experiments with the view of "attenuating," as the term is, the virulence of the anthrax bacillus, but on the whole his results have not confirmed those arrived at by Pasteur. So far as relate to the protective or vaccine influence of the "attenuated" baccili, Koch, who so frequently

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dissents from Pasteur's conclusions, agrees with him that the continued cultivation of the anthrax bacillus lessens its pathogenic power. Koch, Gaffky, and Löffler have recently made experiments which also confirm Pasteur's statement that the anthrax bacillus can, when "attenuated," be cultivated for months or years without further change, or reversion to its original virulence. Koch and Klein agree that the spores of the bacillus are not formed within the blood.

Some interesting experiments with the Bacillus subtilis have recently been carried out by Dr. G. Vandevelde. The results appear in the current number (Tome V., Fascilule I.) of the *Archives de Biologie*, published in Ghent, Belgium. This author's researches have convinced him that the hay bacillus can exist as a ferment for a rather long period. According to Cohn, it can, when cultivated in an atmosphere free from air, evolve from certain bodies butyric acid, but Hans Buchner did not notice any fermentative action produced by it. He quotes Prazmowski's similar experience. Prazmowski introduced spores of Bacillus subtilis into glass tubes, half filled with fermentiscible liquors, boiled and sealed. In those he could find neither bacilli nor fermentation product. But this does not prove that the Bacillus subtilis cannot play the part of a ferment; for according to Brefeld and Hoppe-Seyler's researches, free oxygen is indispensable to the development and reproduction of this bacillus, and Vandevelde's culture of it in meat extracts, confirms these authors' opinion. The same authors have shown that beer-yeast does not multiply without free oxygen; and Hoppe-Seyler goes so far as to say that the same holds good for all the micro-organisms of the group of Schizomycetes, and the analytic results of Vandevelde's operations with the hay bacillus confirm that fact. Therefore, to obtain analytical results, it is evident that the bacillus must have time given to it in order to its development, and that afterwards it must play the part of a ferment to live without the presence of oxygen. It is not till after four or five days (Prazmowski seems to have expected results within four or five days), even when the culture has been carried on in sealed tubes, that products of fermentation may be expected. Prazmowski mentions that when he allowed a small quantity of air into the vassels, the bacillus was developed, but formed only a very thin crust on the surface of the liquid, which became very thick when the air was freely admitted. All this is perfectly consistent with the principle that for the phenomena of development and reproduction, free oxygen must be present, and that they take place in proportion to the quantity of air admitted.

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Chamberland's experiments, carried out on the same principles, led to the same conclusions. The same objections apply to his experiments as to those of Prazmowski—that is to say, too short a time allowed for the development of the bacillus.

Vandevelde's experiments relate to the modification effected in the Bacterium subtilis in meat extracts. The bacilli were obtained by Robert's and Buchner's methods— namely, by immersing hay in water for four hours, bringing the resulting fluid to specific gravity of 1·004, and, after neutralising the excess of acid, half filling litre-flasks, closing with wadding, boiling, and cooling to a temperature of 36°, for thirty hours. When the culture was applied to meat extracts of a strength of 2·5 grammes, 5 grammes, and 10 grammes of meat to 500 cubic centimetres, the following results were obtained:—The liquid, clear at first, became turbid after twenty-four hours, but after forty or forty-eight hours regained much of its clearness, at the same time a crust, greyish white and opaque, was observable at the top, decreasing in thickness from the strongest solution to the weakest. This grey layer after thickening for some time became more shiny and presented a surface more uniform. Soon this broke up and fell to the bottom. After the disappearance of the first layer a second sometimes formed, very thin and transparent. After three weeks if a small quantity of the liquid were taken at any depth, the microscope revealed the presence of bacteria throughout the whole liquid. Mr. Vandevelde interprets these facts in the following manner The bacillus lives and multiplies during the first days at the expense of the oxygen dissolved in the liquid. When this is exhausted it rises to the surface and lives by absorbing the oxygen. But, according to Hoppe-Seyler, in liquids at rest and in fermentation the superficial layer only contains oxygen. What becomes of this layer when there is a crust one and a half millimetres thick? The superficial portion of this crust absorbs a large quantity of oxygen and prevents its access to the lower strata; there the bacillus can neither multiply nor develop itself, and to live has to produce its own heat at the expense of fermentiscible substances. Soon the crust breaks up and falls to the bottom, dies, and remains there. Another portion comes to the top and forms a new crust, and a third exists as a ferment and floats in the liquid.

Dr. Vandevelde comes to the conclusion that the Bacillus subtilis may for a certain time play the part of a ferment, and that if the experiments of Buchner are confirmed, the transformation of the bacillus subtilis is nothing more than the transformation of an organism incapable of living but for a short time in an atmosphere free from oxygen into another

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which can for a while produce the heat it requires for its existence by decomposing fermentiscible substances.

Disease produced by Putrid Food.

Food in a putrid state or in an incipient condition of decomposition often produces forms of *Septicæmia*, or blood poisoning of which the most common symptoms are choleraic. The toxic nature of such food seems to be due to two classes of principles. First, to the presence of micro-organisms of an infective character; second, to the spontaneous generation of crystalline principles resembling the poisonous alkaloids, such as strychnine, veratria, &c.

As to the micro-organisms, but little is known of them. I have already referred to the poisonous moulds, but it seems likely that the bacteria or bacilli in putrid food occasionally cause the illness which decomposing food sometimes produces. Nor is this poisonous food always sensibly putrid, it often has but the faintest mouldy odour; this is especially the case with preserved food, such as tinned lobster, &c.

In 1880, 72 persons who had partaken of beef and ham sandwiches at Welbeck, Nottinghamshire, suffered from choleraic symptoms, some of the affected persons died. Dr. Ballard attributed the illness to the use of the ham, and portions of it submitted to Dr. Klein were found to contain a hitherto undescribed bacillus which proved to be virulent.

Many cases of illness, apparently arising from the use of diseased or putrid meat and other kinds of unsound food, have come under my observation. In August, 1883, near Taghmon, in the county of Wexford, a sick cow was slaughtered and its flesh was consumed by forty-nine persons. It was believed that the animal only suffered from the dry "murrain," merely a kind of indigestion. Twenty-nine of the persons became very ill, and two of them died. The symptoms were similar to those observed in cases of illness from eating putrid sausages. I investigated the case, and came to the conclusion that the cause of death was septicæmia from eating food in a decomposing state. I found that all the persons who had eaten the meat fresh and hot were unaffected, but that all who had partaken of it cold and after it had been kept for some time became ill. In this case the state of disease—simple as it was—favoured the rapid decomposition of the meat. I have always noticed that the flesh of diseased animals soon becomes putrid. In the Wexford case it was surmised that the cow might have had splenic fever; but I did not detect any anthrax bacilli in its

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flesh, though it contained immense numbers of micrococci and bacteria. These probably acted as septic organisms merely.

Ptomaines.

The term ptomaines has been applied to crystalline principles resembling the alkaloids (strychnine, veratria, &c.) found in the dead body, in putrid flesh, and, but less frequently, in decomposing vegetable matter. They have been investigated by B. W. Richardson, Marquardt, Panum, Bergman, Schmiedeberd, Selmi (especially), Schmidt, Pouchet, Brieger, Poeh, Giacomelli, and other chemists, but much remains to be known concerning them. That they occasionally cause illness and even death seems probable.* In the putrefaction of Indian corn, a ptomaine was found by Lombroso and Erba which acted like strychnine. The poisonous properties which sausages, fish, and other foods occasionally exhibit are probably due to ptomaines, not to fungi.

A poisonous alkaloid from toxic mushrooms has been isolated. It is termed *muscarine*. A very small quantity proves fatal to animals.

Dr. Dupré, of London, extracted a ptomaine from a portion of some sausage which had poisoned a number of people.

Conclusion.

The subject of the fitness of the flesh of animals affected with contagious pleuro-pneumonia, rinderpest, foot-and-mouth disease, and other maladies resulting from blood poisoning, I do not propose to consider at present.† These diseases are no doubt the results of the introduction of micro-organisms into the system, but the various *materies morbi* of these maladies have not been clearly identified. The milk of animals affected with foot-and-mouth disease has been proved to produce illness, when drunk uncooked. The milk of even healthy animals often becomes the vehicle of spreading such diseases as typhoid fever, scarlet fever, and probably diphtheria. In this city a few years ago I traced the cause of the illness—fatal in six cases—of 65 persons who had drunk milk supplied from a dairy, the owner of which had fever. The numerous outbreaks of disease which have been caused by the use of infected milk, and the strong evidence shewing the evil results of the use of the flesh of diseased

* Pouchet assigns to one of the ptomaines the following formula:—$C_{17} H_{14} N_4 O_2$.

† I have published several papers on this subject which has also been thoroughly thrashed out by Dr. Vacher, the able Medical Officer of Health for Birkenhead.

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animals are sufficient reasons to warrant the systematic and skilful examination of the food prepared or exposed for sale. The reason for such examination is all the stronger when we consider that food is liable to be the abode of those organisms and alkaloids, the deadly nature of which I have briefly and imperfectly discussed in this address.

Sir ROBERT RAWLINSON, C.B. (President of the Congress), said he was unable to speak with any thoroughness upon so technical a subject, which had been very ably dealt with by Dr. Cameron, and would therefore ask Dr. De Chaumont and Dr. Carpenter to make some observations. He could say, from his own experience as an engineer in the different towns he had inspected, that an enormous amount of diseased food was to be found throughout the country which ought, if one half of this paper were true, to be destroyed.

Dr. ALFRED CARPENTER (Croydon) would answer the call of the President at once, and moved a vote of thanks to Dr. Cameron for his very able and interesting address. The remarks which had been addressed to them with regard to the influence of these minute organisms were—without intending to be rude—beyond the intellectual understanding of a considerable number of those present, but he was quite certain they would gather from the address that there were very important circumstances connected with the spread of disease; that there were very important conditions to be searched out by men of Dr. Cameron's intellect and understanding; and that he, and others like him in different parts of the country, by following out these circumstances, by placing the results of their inquiries before the public, and by leading the public to understand that there was mischief being introduced among their fellow creatures by the sale of articles which were not generally fit for food, would promote the health of the people and the ultimate advantage of all concerned. The way in which impure articles of food were sold among the poor and distributed by the producer, the way in which the meat of diseased animals was foisted upon the market and sold as good or second-class meat, tended very much to the production of disease; and the remarks of Dr. Cameron ought to induce them strongly to combat the development of trade in impure articles of food, and by this means assist in promoting the health of the people. Although all of those present might not be able to follow the details of the paper, the inferences drawn from them would not be lost sight of, and he hoped those present would accord the author their thanks.

Surgeon-General DE RENZY (Bray), who seconded the motion, gave from his Indian experience instances of the prevalence among certain natives of round worm, the ova of which appeared to have been

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derived from impure drinking water, the disease ceasing upon the natives being supplied with pure water. In another remarkable case, round worms prevailed to an immense extent among the lunatics in an asylum near Calcutta; the cause of the prevalence of the parasite was investigated again and again, apparently with little result, until suspicion fell on the water supply; and in the end, when the old tanks were abolished and only the pure water brought in was used, the worm was got rid off from the asylum. The evidence with regard to Guinea worm was also to the same effect. This worm formerly prevailed considerably in Bombay, which was then supplied with water from foul and stagnant tanks, but since the introduction of a good water supply in 1865, the parasite had become extremely rare.

The motion for the vote of thanks was then agreed to, and Dr. Cameron briefly replied in acknowledgment thereof.

On "A New Process for Treating and Drying Blood, so as to fit it for use as Manure without creating a Nuisance," by W. G. STRYPE, C.E.

The rapid manner in which the blood of animals decomposes, emitting offensive emanations dangerous to health, has presented considerable difficulty in preparing it for use. Blood contains about 75 to 80 per cent. of moisture, which has to be evaporated in order to prepare it in convenient form for agricultural or other purposes, but the operation of drying, as usually performed, tends to aggravate the nuisance by the increased emission of noxious vapours. In some measure this difficulty has been lessened by drying the blood in closed vessels heated externally with steam, or by other means; the vapours being conveyed from the vessels under a large furnace, and their noxious character more or less destroyed by the fire, and mixing afterwards with the products of combustion, pass up the chimney shaft; the emanations considerably diluted enter at a high level into the atmosphere, and consequently their evil effects are not so marked. In hot climates, such as are met with in the South American States, where the slaughtering of cattle is carried out upon a very extensive scale, the blood is frequently allowed to run waste, the slaughter-houses being situated alongside a river. Sometimes the blood is collected and dried by means of the sun, but this process is attended with the most offensive and

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injurious emanations, such as would not be tolerated in the vicinity of any populous locality. The high value for agricultural purposes which dried blood possesses has led to its being prepared for use in such localities by this rough method of exposure to the sun's heat, notwithstanding the nuisance it has caused. In our large towns, where considerable numbers of cattle are daily slaughtered for the purpose of food, most of the blood is run to waste, owing to the difficulty of treating it; but when it is treated the process is usually attended with dangerous emission of noxious matters; so that I trust this Congress of the Sanitary Institute of Great Britain will regard the subject as one of interest from a sanitary point of view, and anything calculated to remove the cause of the nuisance of importance.

My attention has been directed to this subject in connection with the manufacture of sulphate of alumina, and some of the many sanitary purposes to which that material can be advantageously applied. It has been generally known that the ordinary hydrated sulphate of alumina has the property of abating the nuisance arising from the naturally rapid decomposition of blood, but the quantity necessary to do so is considerable, as it is almost impossible to thoroughly mix the dry sulphate with the blood so as to secure deodorization. During the great number of experiments which I made I found the same difficulty, which is due to the fact that the dry sulphate, as usually added, dissolves very imperfectly in blood, and consequently leaves large portions unacted on, so that practically no beneficial effect follows. The treatment with sulphate of alumina has not therefore been a success, or indeed employed on a large scale. Hydrated sulphate of alumina, as now manufactured, is very soluble in water and especially in hot water, and I found that if the sulphate were previously dissolved in water all the difficulty would be overcome, as the solution so obtained could be added to the blood so as to be intimately incorporated with every particle of it. I found that so small a proportion of the hydrated sulphate of alumina as the one-fiftieth, or even the one-sixtieth part, when added in the form of a solution, was quite sufficient to entirely destroy the offensive and dangerous odour, and the resulting mixture of blood and sulphate of alumina could be afterwards dried to prepare it for use in an open pan heated with a fire or other means without nuisance; the slight odour emitted during the process of drying is rather a pleasant one than otherwise, somewhat resembling that from the roasting of a fresh joint of beef. The most desirable method of adding the sulphate to the blood is to place in a shallow tin dish of suitable dimensions a small measured quantity of the solution, containing about three-quarters of a

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pound of the sulphate of alumina, and to allow the blood from the slaughtered animal to flow into it. A full-sized animal gives about forty-five pounds weight, or about four-and-a-half gallons of blood. A collecting vessel is placed close at hand, and the contents of the dishes are from time to time poured into it, where it shortly afterwards more completely coagulates, and not the least trace of offensive odour occurs. This method of treatment, which I have patented in this and in other countries, is now being carried on upon a working scale by the Dublin and Wicklow Manure Company, who collect all the blood from the animals slaughtered at the public abbatoir which the Corporation have recently erected in this city. The blood is conveyed to the company's works at Ballybough Bridge, and there dried in open pans, without the emission of any offensive odour, or the least inconvenience to the workmen, and without any danger whatever to public health. All the vessels used in the several operations are rinsed out with the solution of the sulphate of alumina, and are kept by that means inodorous and clean. The dried blood obtained is of high fertilizing value, and contains nitrogenous matter equal to 14 or 15 per cent. of ammonia.

I have also had this treatment carried out upon a large scale, and with considerable success, at some of the slaughtering establishments (or *Saladeros*, as they are locally called) at Monte Video, in the State of Uraguay, where upwards of 500 animals are slaughtered in each Saladero per day on the average during the season; and very extensive operations are now being made for working the process in this and other countries, where the slaughtering of animals is carried on extensively. These animals are smaller than ours and do not yield more than about 35 lbs. of blood each. The blood drains across the slaughtering floor and passes into a small conduit placed along one side of it, which leads it into one of two or more collecting tanks into which the solution of sulphate of alumina is placed. In a short time the mixture thickens, and the contents of the collecting tanks are shovelled out and spread upon the surface of the ground, where they are exposed to the heat of the sun. The climate being a hot and dry one during the slaughtering season, the blood is perfectly dried fit for exportation in a day or so, and no emission of offensive or dangerous odour takes place; while an important material can in this way be turned to a useful purpose, the greater portion of which was hitherto lost, being a source, even when wasted, not only of considerable nuisance, but also the loss of a valuable fertilizer, which is now by this process turned to profitable account by those engaged in the industry.

It will be seen that the process of drying and preparing blood

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for use by this method is of extreme simplicity, not requiring any extensive arrangements or expensive plant. The quantity of sulphate of alumina required is so small as not to appreciably effect the cost of production, while the dried blood obtained is readily prepared and is of considerable value, being at the present time worth about £6 or £7 per ton.

Mr. Moss, F.C.S., Hon. Sec. of the Section (Dublin), said the great simplicity of the process commended it to manufacturers. The employment of the aluminium sulphate in solution instead of in the solid form, ensured that intimate mixture that was necessary in order to obtain the full effect of the reagent. If the process could be successfully applied it would facilitate the utilization of an immense quantity of valuable material.

Dr. H. C. Bartlett (London) had also been struck with the simplicity of the process, which was one of the first essentials in dealing with a matter of the kind. The main questions for consideration were whether it could be applied inexpensively for the removal of a nuisance, whether it payed or not, and whether it could be made to pay. If it would not pay he was afraid that, however valuable it might be in getting rid of the nuisance, it would not be adopted, except as a necessity. In many small country towns abbatoirs were badly looked after, not because the inspectors were remiss, but because they could not always attend at the time of slaughter; but if this system could be adopted he had no doubt nuisance would be removed or avoided; in such instances this process would be invaluable. He had inspected the manure works where this new process was being carried on, and there was none of the disgusting odours of blood and decomposition which usually rendered such an operation one of the most noisome with which he was acquainted. Taken altogether, this easy and effectual disposal of the refuse blood, which cannot by this means become a nuisance, is very satisfactory.

Prof. W. H. Corfield, M.A., M.D. (London), said it was provided by an Act of 1844, that in thirty years from that time, certain trades or businesses which were declared to be offensive trades should cease to be carried on in or near London, among them being the boiling of blood and the slaughter of cattle. Any medical officer who had had to do with it knew what an offensive business blood-boiling was, and what a difficult thing it was to prevent nuisance in the neighbourhood; and as to slaughtering too, how difficult it was to superintend a number of slaughter-houses scattered about, and to prevent the sale of the meat of animals that had not been killed but

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had died. In 1872 a tremendous outcry was raised by the London butchers because they found out that in two years they would not be able to continue slaughtering in private slaughter-houses, and the result of their outcry was that a Bill was passed enabling the business of slaughtering to be carried on under certain regulations. That showed how difficult it was to get rid of these trade nuisances. The special regulations provided, that if the owner of a business did not get all the necessary appliances and keep them in good working order, action could be taken against him to make him remove to some place outside the parish; but this Act was, if not quite, almost a dead letter; it was exceedingly difficult to carry out, as the people proceeded against brought evidence to show they had done all that was required, and it was by no means easy to bring a case to a successful issue. The result of it all was that a nuisance, admitted to be so as long since as 1844, continued to exist. As to the process of Mr. Strype he would, as one of the judges who had not yet made their report, express no opinion, except to say that in what he had witnessed there was none of the nuisance experienced in an ordinary blood-boiling establishment, that to be thoroughly successful it must be carried out on a large scale, and that therefore it would probably be a help to the construction of public abbatoirs, and the abolition of private slaughter houses.

Prof. F. DE CHAUMONT, M.D., F.R.S. (Southampton), who had also had an opportunity of visiting the works, considered it his duty, as one of the judges, to be equally reticent, but could corroborate what had been said as to the simplicity of the process and the absence of nuisance.

Dr. F. VACHER (Birkenhead) thought that inasmuch as the success of the plan depended upon its being carried out upon a large scale, it would have a tendency to encourage the adoption of large public slaughter-houses, in place of small private ones, and it would thus be productive of good. In many small towns every little butcher's shop had its slaughter-house, and blood did not pay anyone to collect, and so was a distinct loss to the butcher and a nuisance to the locality. It might therefore be found worth while to supply butchers doing a small business, with the solution of sulphate of alumina with which they could treat the blood; this could then be collected once a week or once a fortnight, and it would then only have to be dessicated.

Dr. CHARLES A. CAMERON (President of the Section) said Dublin had a very good *abbatoir* which was not worked at present to anything like the extent that had been hoped for when it was established four or five years ago. It was just outside the city boundary, and they could not compel the butchers to use it. He hoped an Act of Parliament dealing with the question would be passed, due regard being paid to vested interests, and that slaughter-houses in the city would be done away with.

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Mr. STRYPE (Dublin), in reply, said the observations on his paper had been very friendly. There was no difficulty in carrying on the process on a large scale, when he believed it would pay very well indeed. The price paid to the corporation was equal to £1 per ton of wet blood, containing about seventy-five per cent. of water, so that it required four tons of wet blood to produce one ton of dry blood, and therefore the cost of the raw material amounted to £4 per ton. The cost of preparation, when carried out upon a tolerably large scale, was from £1 to £1 10s. per ton, including sulphate of alumina, royalty and all charges. The scale upon which they were now carrying out the process was not so large, from the circumstances mentioned by Dr. Cameron, but the process, even as now carried on in Dublin to the extent they were limited to, had already shown a moderate profit.

On "The Influence of Food on Health," by FRANCIS VACHER, F.R.C.S.Edin., F.C.S., Medical Officer of Health, Birkenhead.

In any comprehensive review of public health the influence of food supplies cannot be left out of the reckoning. The influence is apparent year by year. One year, it may be, an abundant harvest makes corn cheap, legislation restrictions make butchers' meat dear, and a run of rough weather along the coast practically forbids the use of fresh fish to all but the wealthy. Another year matters are reversed, wheat is up to 50s. a quarter, meat is within reach of the poor, and the fisheries are exceptionally successful. The influence is not less apparent in different countries. One nation's food supply consists mainly of oats or rye and milk, another's chief supply is potatoes, salt meat and fish, and butter milk; another's is sour bread and wine, and fresh fruit. The influence is apparent in comparing the health of town and country, or summer and winter. The influence of food on the health of small communities, families and individuals is often not less striking.

In truth, in trying to solve any health problem, food becomes a very important factor. Is the general death rate or zymotic death rate the subject of investigation, or an increased infant mortality, or the cause of a specific epidemic or endemic disease; in every case food, no less than air, water, climate, ground, occupation, environment, and many other things, must be carefully considered.

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Of course, if the food supply is sufficient in quantity, sufficiently varied, excellent in quality, of a kind suited to the season and climate, and adapted to the occupation and habits of the consumer, if it be eaten slowly and allowing regular intervals of time sufficient for digestion and rest, its influence can be only beneficial. The question, therefore, which immediately concerns us, and which it is proposed now to discuss, is—

Under what circumstances is food other than beneficial?
Under two circumstances.

(1). The food, faultless in itself, may be so unwisely used that it, or a portion of it, may be other than beneficial. Thus—

a. It may be in excess.
b. It may be insufficiently varied.
c. It may be ill adapted to season or climate, occupation, habits, or temperament.
d. It may be eaten too quickly, or at too high or low a temperature.
e. It may be eaten just before or after extraordinary physical exertion, just before sleep or sea-bathing, &c.

(2). The food may itself be defective. Thus—

a. It may be too hard or tough.
b. It may have undergone acid fermentation.
c. It may have undergone putrefactive change.
d. It may be injuriously adulterated.
e. It may be diseased.
f. It may be infected with the contagium of a human disease.

The circumstances, as set forth in my first list, under which wholesome food may influence the consumer's health prejudicially, are circumstances each individual for the most part controls for himself. They are thus matters of personal hygiene—problems every one must solve for himself from his experience and observation, and if necessary, assisted by the advice of the family physician. No hard-and-fast line can be drawn with reference to them, no rule laid down. Having mentioned them, therefore, I pass on to consider the various conditions which depreciate the quality of human food, or render it positively injurious.

Hardness or toughness is a defect more frequently manifest in butchers' meat than in other food; but cheese, salt fish, fresh fruit, rye or oaten bread, may be hard enough to be

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injurious to the consumer, a considerable proportion passing through the alimentary tract undigested, and acting as a mechanical irritant. In butchers' meat toughness is due to several causes; chiefly, I believe, to the meat being badly cooked, or too fresh, or being derived from aged animals, especially entire males. Some samples of jerked beef and ships' pork occasionally met with are so dry, that after ample soaking and cooking, they become little more nutritious than leather. Fortunately this property of food is one readily appreciable by the senses, and one any housewife is competent to judge of.

Sourness.—This term is, I think, not generally understood by the public. Most people know that when milk turns sour the sugar in the milk has become converted into an acid, but they have not heard of the little active egg-shaped bacterium, by whose action this change is brought about. It is probable that whenever souring takes places the process is started by means of a low form of organism growing and multiplying, in much the same way as alcoholic fermentation is brought about by another organism. Souring does not necessarily render milk unfit for food, as the change effected is not dissimilar to that which takes place when digestion commences in the stomach, but milk thus changing or changed readily putrefies and forms a soil for the growth of germs undoubtedly injurious. For instance, the rod-shaped bacillus of so-called "blue milk" only grows in an acid medium, and probably the oidium, &c., can only infect acid milk. Butter which is not actually rancid is often a little sour from the bad practice of making it from sour cream; that is, the curd (which usually exists to the amount of about 4 per cent.) is not free from acid when the butter is made. In this way often rancidity begins.

Bread is also often sour, though less frequently in this country than in France or Germany. Sometimes the bread is made sour intentionally; especially is this the case in bread made with leaven; but in this country, when either bakers' bread or home-made bread is sour it is due to fermentation having been allowed to proceed too far. The acids present in such bread are acetic and lactic. Cheese also is sometimes sour, especially inferior qualities and sheeps' milk cheese. Finally, butchers' meat is occasionally sour. Sometimes, I believe this is due to the animal having been affected with rheumatism, but more frequently to the presence of milk in the meat. I have seen many such cases. The animal is killed shortly after calving. There is what is called "milk fever," or the udder is too inflamed and

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sore for milking. The sourness of butchers' meat is also, doubtless, due to other causes. Of course, sourness in meat to be injurious must be well marked, as healthy meat has naturally a faint acid reaction. Generally, it may be said that sourness in foods renders them liable to the attacks of mould and fungus and to decomposing agents.

Putrefaction.—Just as the little *torula*, the yeast granule, excites fermentation in liquids containing sugar, in which it grows, so do allied organisms excite putrefaction in animal or vegetable matter. Thus putrefaction is a form of fermentation, or rather many forms of it, excited by bacteria of different kinds. The foods which are most frequently exposed for sale when undergoing putrefaction are cheese, game, fish, sausages, cooked meat, and fruit. It is a curious fact that game, even in an advanced state of putrefaction, may be eaten with impunity; but it occasionally gives rise to considerable intestinal irritation. Cheese, too, not merely attacked by mites and blue mould, but swarming with the bacteria of putrefaction in parts, and bitter to the taste, is doubtless often eaten without ill effects. However, cheese in this condition is not wholesome, and cannot be eaten without risk. Fish, undergoing putrefaction, is probably still more dangerous as a food, and in this country rarely used, even by the very poor; yet it is known that the Chinese, Burmese, and some other nations habitually eat putrid fish as a condiment, and without any known ill effects. Sausages, brawn, cooked meat from pies and tins, &c., have often been known to produce symptoms resembling those of acute poisoning in families or groups of people partaking of them. On examination of the viands it is seldom that any definite poison has been discovered—there has been some softening, a slight putrid smell on boiling, and the ubiquitous bacteria. Uncooked meat is not rarely offered for sale in a putrefying state, especially the cheaper portions of a carcase, the brisket, strippings of ox heads, &c. Such meat finds a market in poor neighbourhoods late on Saturday nights. Some of the nausea and vomiting ascribed to drink may be due to suppers of such meat. Fruit also, of various kinds, is retailed in the streets in a half-putrid state, especially in July and August, and is one of many causes of summer diarrhœa. As the signs of putrefaction are manifest in fish, flesh, fowl, or fruit, if people eat tainted food they do it knowingly, or for want of the exercise of ordinary care.

Injurious Adulteration.—It will hardly be necessary for me to point out that a large proportion of the adulteration that takes place is not, strictly speaking, injurious. Thus, when the flour of rice, barley, or maize is added to wheat flour, or a

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preparation of sweet beef fat is added to butter, the purchaser may be swindled, but he buys a good wholesome food nevertheless. Of the ordinary foods in use in this country, I think I am justified in saying that only a few are injuriously adulterated. Flour is said to be adulterated with gypsum (sulphate of lime), chalk (carbonate of lime), and ground soapstone (silicate of magnesia); but since the passing of the Adulteration Acts it must be to a very limited extent, as any of them could be detected by simply burning the flour. Much has also been written on the adulteration of bread with alum, but I doubt if this is practised to any extent. It is a significant fact that pure wheat flour has been found to contain a quantity of alumina equivalent to from 2 to upwards of 40 grains of ammonia alum for 4 lbs. Thus, it is not improbable that the alumina occasionally detected in bread is a sophistication effected by Nature. The presence of lime or soapstone in food might produce constipation and dyspepsia, and alum might do this or might simply retard digestion. Milk is dishonestly manipulated mainly in two ways, by watering and skimming. When the added water is pure and the cream is removed with a clean instrument, and clean hands, the milk, though less nutritious, is certainly not injurious. The foreign substances added are for the purpose of keeping it or increasing its density; they are soda, borax, salicylic acid, salt, sugar or glycerine. Some of these, especially salicylic acid, might prove injurious to children and invalids. Confectionery is often coloured with mineral substances, as white and red lead, chromate of lead, vermilion, verditer, the bright green arsenite of copper, picric acid, and the aniline dyes, with many others, all of which are positively injurious. The so-called essences added as "flavourings," acetate of ethyl, acetate of amyl, &c., are scarcely less unwholesome. Tinned peas and green vegetables, fruit, and pickles, are well known to be adulterated with salts of copper, probably acetate of copper. Happily, mineral substances are all readily detected by analysis. But if there were no demand for bright tints in confectionery, pickles, &c., there would be no temptation to manufacturers to add such adulterants. The symptoms which may arise from eating such food are those of acute poisoning. Sweets are also largely adulterated with gypsum, which I have already stated is constipating, and occasionally coloured with gamboge, a powerful drastic. Mustard and egg powders are said to be sometimes coloured with chromate of lead, and curry and cayenne pepper to be coloured with red lead, &c., but I should think such adulteration uncommon in this country.

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Diseased Food.—The foods which may be themselves diseased are corn, milk, butchers' meat, fowl, fish and fruit.

The most common diseases of corn in this country are bunt, smut, and ergot. Bunt frequently affects wheat, and grows within its seed, producing a fine powder. This powder feels greasy when rubbed between the fingers, and has an unpleasant smell. Smut commonly attacks barley, oats, and rye, seldom wheat. It produces a powder finer than bunt, and has no smell. Ergot, for the most part confined to rye, but also attacking other corn occasionally, develops early in the grain, taking the place of the solid contents. It has a sour smell. The spores of all these parasites may be seen under the microscope, those of smut as small round granules, those of bunt round and reticulated and three or four times the diameter of smut, and those of ergot egg-shaped. Bunt and smut certainly render the flour or bread containing them less wholesome; the latter is said to produce diarrhœa. Ergot is even more deleterious, exciting a specific action on the involuntary muscles, and if the use of food containing it be long continued resulting in the disease known as ergotism.

Most fruit is liable to the attacks of various fungi and of other parasites, which may give rise to a considerable amount of gastric irritation and depression, or even to choleraic symptoms. Indeed it is probable that acute attacks of diarrhœa ascribed to the ingestion of unripe fruit are often due to the presence of parasites. As parasitic disease tends to affect the surface and the centre of fruit, a safe precaution is to remove the peel and the part lying next the core or the stone. It is also well to remember that all risk is avoided if the fruit be thoroughly cooked.

Milk may be diseased in three ways; it may be derived from a cow suffering from a specific epizootic disease, from a tuberculous cow, or from an inflamed udder. The danger of milk being specifically infected is not nearly so great as might be inferred, the milk secretion being, in most epizootic diseases, entirely arrested. The only two diseases in which it is usual for the milk to continue to be secreted are pleuro-pneumonia and foot-and-mouth disease. Milk from pleuro-pneumonic cows has been commonly sold, looks wholesome, and is not known to produce any ill effects. Milk from a cow affected with foot-and-mouth disease is diminished in quantity, richer in butter, sometimes contains vibriones, &c., and readily sours. It is certainly unwholesome, and, there is no doubt, when ingested raw, may produce in the human subject a disease closely resembling, if not identical with, foot-and-mouth disease. The question whether milk derived from tuberculous cows can be

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used for human food with impunity has recently been much debated. It is exceedingly difficult to get direct evidence bearing upon the point. Having read much upon the subject, I am yet unable to say a good case has been made out against such milk. Still I think it is only reasonable to admit the possibility of tuberculous milk infecting the consumer. The disease is not uncommon among cows. They may be in good condition and good milkers and yet have tubercle. Cows, especially those in high condition, readily get inflamed udders, the common causes being cold, overdistention of the udder from being long unmilked, bruising from unskilful milking, leaving a residuum in the udder, and pressure from an awkward way of lying. Milk from such udders is usually said to be gargety. The milk is ropy or quite curdled, and may contain pus, bloody serum and other effete matters, and could not meet with a ready sale by itself. Mixed with the rest of the produce of a dairy it may escape notice. How then may milk infected in either of these three ways be rendered innocuous? Of course if the milk is streaky, or the least bloodstained or smells bad it should be rejected. But as milk may be diseased and yet afford no physical sign of disease, it is well that it can be rendered wholesome by the simple process of boiling.

Of diseased fowl and fish but little is known. Poultry suffer from many diseases, but the only one there is reason to believe may prejudice the flesh so as to make it unfit for food of man is fowl cholera. Though called fowl cholera, ducks, turkeys, geese and pigeons are all subject to the disease. The flesh is somewhat redder than natural, the liver softer, the heart speckled with red or dark spots, the intestines are inflamed and marked with red or livid patches. However, in birds carefully prepared for the market there may be little evidence of the disease. Fish apparently healthy and in season have occasionally affected consumers very seriously, the symptoms resembling those of poisoning; but attempts to isolate any poison have failed, and it is thought their flesh may have been tainted by their having fed on diseased or unwholesome food. It is known also that fish are subject not only to entozoa, which do not commonly render them unfit for food, but to many parasitic diseases, which make them unfit for food, the visible signs being a fungus which eats its way from the surface into the sound flesh.

As regards the diseases of animals from which butchers' meat is derived there is more exact information, but I have only space to refer to the matter very briefly here. The diseases ordinarily met with or likely to occur in home-bred

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or imported animals which should be regarded as rendering the meat unfit for food of man are: *in oxen and sheep*, cattle plague, epizootic pleuro-pneumonia, anthrax, and sheep-pox; *in swine*, typhoid fever, epizootic pleuro-pneumonia, quinsy, and the parasitic diseases known by the presence of cysticerci and trichinæ. Most of these diseases disfigure the carcass sufficiently to exclude it from the meat market. However, pleuro-pneumonic beef is often exposed for sale, and may generally be known by its darkened appearance and the absence of firmness. Cysticerci if swallowed alive produce tapeworm in the human subject, and trichinæ under similar conditions produce themselves in great numbers, giving rise to a terrible disease, which may prove fatal. Cysticerci give to pork a measled appearance sufficient to attract attention, but the fine speckling indicating the presence of trichinæ is not likely to attract attention ordinarily. The effect of eating meat tainted with anthrax, especially if the meat were underdone and the person eating it had a mouth-wound, might be to produce anthrax itself. The symptoms the other diseased meats would be liable to produce would be depression, surface coldness, diarrhœa, and vomiting.

Besides the diseases I have named, there are others which depreciate the quality of the meat and render portions of the carcass unfit for food of man, or in their later stages render the whole carcass unfit for food of man. These are tuberculosis, foot-and-mouth disease, hoof-rot, rheumatism, dropsy, and liver-fluke. What steps, then, should the public take to guard against the ill-effects of diseased meat? Till more efficient inspection is obtained, which by the way is greatly needed, all that can be done is to be very careful to reject meat which is not firm, and does not look and smell perfectly good, and to make certain that every joint is thoroughly cooked.

Infected Food.—Almost every kind of food is liable to be infected with the germs of human disease. These germs are very abundant. They are given off from the lungs in one disease, from the throat in another, from the skin in another. We know that they rest on the surface of rooms, and furniture, and clothes, and foods; and it certainly appears that those resting on foods are *prima facie* more likely to retain their vitality than others. Some of them are killed by drying, and probably all may be killed by the action on them of the oxygen in the air. In contact with most foods they obtain moisture, are sheltered from the action of the air, and furnished with such food as they can assimilate.

As, however, they cannot penetrate below the surface of foods there is practically no risk of infection from such things as

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meat, poultry, fish, vegetables, &c. Bread, biscuits, butter, cheese, fruit, and some groceries which are not subjected to any cooking process after they leave the vendor's shop may all become the carriers of infection. There is one food, however, which beyond all others is specially susceptible of infection, that is milk. The risk there is of infection being conveyed by means of all other foods is small indeed in comparison to the risk in the case of milk. Again and again have specific outbreaks of disease been traced to contagium mixed with the milk. Last year Mr. Ernest Hart read a paper at the Social Science Congress, in which he gave particulars of 82 epidemics due to infected milk which had occurred since 1873. The total was made up of 53 of typhoid fever, 17 of scarlatina, and 12 of diphtheria. The number of cases of disease traced to the drinking of infected milk is, according to Mr. Hart, in round numbers, as follows:

Typhoid fever	3,500	with	400	deaths
Scarlatina	800	„	120	„
Diphtheria	700	„	60	„

How many other human diseases, besides these three familiar ones may be carried by milk is uncertain, but it is exceedingly probable that measles may be thus conveyed, and almost certain that one way in which diarrhœa spreads is by means of the cheap watered milk supplied to the poor. I have elsewhere pointed out that milk is also liable to be contaminated with the contagium of glanders and some other animal diseases. It is hardly necessary to state that in most of the instances in which typhoid fever and diphtheria have been delivered in the milk-can, the contagium has been introduced by means of water—the dairy vessels have been rinsed out at a polluted spring, or the milk has been deliberately diluted. The remedy in the case of infected milk is, as in the case of diseased milk, to take care that it is thoroughly boiled.

The subject of the influence of food on health is so far-reaching and the time at my disposal so limited, that my remarks, as I cannot but be conscious, have been somewhat superficial. Still, I trust that my experience as a meat inspector and food analyst has at least enabled me to keep within the limits of truth and common sense.

Surgeon-General A. C. C. De Renzy (Bray) called attention to the fact that the dangers involved in the use of infected milk had only recently become known and appreciated. Previous to the year 1868

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he believed there was no suspicion that typhoid fever or any of the zymotic diseases were spread by means of infected milk, and certainly it was very remarkable that up to that time the danger of such a medium had been unsuspected.

Professor HULL (Dublin) called to their remembrance the outbreak of typhoid fever in Dublin, which, he believed, Dr. Cameron had been the means of tracing to the milk supply. Ever since he himself had taken the greatest pains to secure that the milk consumed in his household came from a pure source; while as to the milk he used for making his mid-day coffee, and which came from a source with which he was not acquainted, he invariably boiled it before using it, and so knew that he was comparatively safe.

Dr. J. W. MOORE (Dublin) said the outbreak referred to was fully investigated at a largely attended meeting of the Medical Society of the King and Queen's College of Physicians, and the almost universal opinion expressed by the speakers in the debate was that Dr. Cameron had conclusively proved the connection between the epidemic and the use of polluted milk. There were so many other cases, in which a similar connection had been traced, that it was now admitted on all sides that impure milk was capable of conveying disease. The maladies most likely to be carried in this way were undoubtedly typhoid fever and scarlatina.

Dr. W. J. SIMPSON (Aberdeen) said there was, unfortunately, an idea in Scotland that the addition of water to milk was not adulteration; and this might, perhaps, be so if the water added were pure, but unfortunately they had had experiences of water from contaminated wells being put into milk, by which means disease had been spread in the large towns. In regard to food, they required better inspection, and more stringent penalties for offenders.

Mr. G. J. SYMONS, F.R.S. (London), would not have risen to speak upon a medical question, but desired to mention that the neighbourhood in which he lived, in the North of London, suffered last year from a violent outbreak of typhoid fever; it was said to have been traced to a farm near St. Alban's, where water taken from a contaminated well had been used in washing the vessels used for the milk supply. The question of fines had been alluded to; now in the case just mentioned the man who served the milk supplied over 2,000 customers, and an outbreak of such a kind being said to have come from his establishment would be a heavier punishment to him than any pecuniary penalty. But the milkman was supplied from a large number of farms, and as soon as that particular farm was proved to be a source of disease his supply from it was stopped. The matter did not, however, end here. One would have thought that the farm would have been put thoroughly right, but that did not seem to have been the case, for it was said that milk from it was supplied to St.

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Alban's, and an outbreak of typhoid fever had since occurred in that city.

Dr. S. T. TAYLOR (Norwich) said he had frequent requests for pills to cure ailments due to the extreme purity of the bread we use. Bread was getting purer every day, and an admixture of bran or the use of whole meal would be of very great advantage.

Dr. EDGAR FLINN (Kingstown) gave an instance from his experience in Staffordshire of the dissemination of scarlet fever by milk.

Dr. CHARLES A. CAMERON (President of the Section) agreed that there was now very little injurious adulteration in the foods in use in the United Kingdom. Dublin was the only city in which the first Adulteration Act was brought into operation. He found many articles were adulterated, though not to a considerable extent: bread, to a small degree, with alum and with potatoes; tea was sold consisting largely of leaves containing little or no soluble matter; confectionery was adulterated with plaster of Paris—they had obtained eight convictions in one day; sugar stick with vermilion (sulphide of mercury) for the red, and chromate of lead for the yellow; *terra-alba* was largely used in the cheap kinds of confectionery. Now no article was adulterated to any extent worth speaking of except milk. In regard to the Dublin fever outbreak, the dairy in question was not supplied with any sanitary accommodation whatever; there were three cases of fever in the house, and the house refuse was carried between two rows of cows and thrown upon the manure heap in the dairy yard. The milk absorbed the emanations from the manure heap.

Dr. F. VACHER (Birkenhead), replying to Dr. Taylor's observations, said he was a very warm friend of the Bread Reform Movement, which had now taken so strong a hold in many towns. He believed its promoters placed in our hands a bread that was not irritating, and which yet contained all the nutritive constituents of the grain. To meet the difficulty experienced in tracing out the source of an outbreak of fever, where the milk supply was suspected, he had obtained the insertion of a clause in the Birkenhead Improvement Act, 1884, by which every milk vendor within the borough was required, on application from the sanitary authority, to give a list of his customers supplied with milk on any day or days, and their addresses, for which the local authority were permitted to pay a small charge.

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On "Potable Water and its quality, as supplied to the Towns of Ireland," by CHARLES A. CAMERON, F.R.C.S.I., S.S.C.Camb., M.K.Q.C.P.

The results of many years' experience in the examination of potable waters have convinced me that a very large proportion of those used in this country are below the standard of a fairly pure water. No doubt a similar state of things exists in other countries. The extent to which the health of communities is affected by the quality of their water supplies has not been accurately determined; but there is evidence to prove that, in the case of many districts, the state of public health has been improved by the substitution of pure for impure supplies of water.

There is some difference of opinion as to what constitutes the purest potable water. The majority of chemists appear to consider such water as that which Glasgow obtains from Loch Katrine the best for all domestic purposes. This water really differs but slightly from rain. One gallon (70,000 grains, or ten pounds in weight), of it evaporated to dryness, leaves only from 2 to 2½ grains weight of solid matter. If the latter be burned, about one half (the organic part) disappears, leaving the mineral, or inorganic part. Loch Katrine water, therefore, contains only about one part of organic matter and one part of mineral matter in 70,000 parts. This kind of water is usually not very sparkling. Many persons do not like its "flat" flavour so much as that of water taken from springs or wells, and containing from 10 to 100 grains of solid matters per imperial gallon. There is generally less dissolved gas in the soft water of Loch Katrine, and its temperature is in summer higher as compared with spring and well waters.

Some persons believe that very soft waters are not so wholesome as moderately hard ones, owing to the absence of lime compounds in the former. No doubt this earth is an abundant constituent of animals; but there is no good physiological proof of the truth of the assertion that the lime of our bones is procured from the water we drink. By far the greater portion of the lime in the animal system is combined with phosphoric acid, whilst in water it is united with carbonic acid and sulphuric acid (in some waters there is chloride of calcium). It seems strange, therefore, that lime should be

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obtained from water and phosphoric acid from some other source. I am one of those who prefer soft water to hard water for a town supply; for although in many instances the flavour of hard water is pleasanter, yet for cooking and washing purposes the soft water possesses great advantages over the hard one. Beside, I do not believe that the lime in water contributes to the nutrition of animals.

The Dublin pipe-water is derived from the impounded drainage of a mountainous region. It contains 4½ grains of solid matters—one-half of which consists of organic matter, nearly altogether derived from peat.

The water supplied to Irish towns contains, with very few exceptions, a larger amount of solid matters than is found in the Vartry water. The colour of the latter and of Loch Katrine water is a very faint yellow, whilst most of the high-pressure waters supplied to the Irish towns have a colour varying from a faint yellow to a brownish hue.

In selecting a water for a town supply, due regard should be had to colour—the lighter it is the better. The very brown waters are usually much objected to, even when it is known that the colouring matter is derived from peat, and is therefore comparatively innocuous. When water is impounded in reservoirs it often happens that its colour gradually becomes deeper; this change is due to the vegetable matter of the soil and of the reservoir becoming soluble and entering into solution. After a time, which may be from one to three years, the water will lose much, perhaps nearly all, its colour—this has happened in the case of the Vartry and Knockaderry (Waterford) waters. The nearer the amount of solid matter approaches that contained in the Vartry water the better—it is undesirable that it should exceed 14 grains per gallon.

It is most important to ascertain carefully the extent of the drainage area proposed to be utilised for a water supply, and also the rainfall of the district where several sources are available; that which yields the clearest water should be selected, so as to avoid the expense of filtration. The greatest attention should be given to the nature of the industries carried out upon the drainage area. If there be no factories or arable farms so much the better. If there be villages or even isolated dwellings, the sewage from which would probably enter a projected reservoir, the means of diverting such objectionable matter should be considered before the commencement of operations. It sometimes happens that the sources of impurities on a catchment area are so numerous and serious that they cannot, economically, be satisfactorily dealt with.

As a rule, I do not like supplies of water taken from large

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rivers: I prefer the collection and impounding of springs and streams in hilly regions. In the former case the water, as a rule, has to be pumped up into "service reservoirs," which is more or less an objectionable process; in the latter case the water can be delivered, by its gravitating power, with any desirable pressure, to the points of consumption. Lakes, especially those of large size, afford in general better water than rivers. A little sewage entering the former has an inappreciable effect upon its composition, whilst upon a river its effect might for a time be very serious.

Springs in the limestone rocks often afford an abundant supply of water; it is usually hard, but this is generally its only bad point. The spring waters may be conveyed by means of small earthen or iron pipes (even gas pipes, as Sir Robert Rawlinson suggests, may answer) direct to small towns. In cases where there is a river ascertained to be free from pollution, its waters might be delivered under pressure, if pumped into tanks by means of turbines. These machines, so much used in America and other countries, are rarely employed in Ireland. It is not desirable to have the service tank placed in or very close to a town, as its water is liable to become contaminated with soot and other matters.

For many small towns a good supply might often be procured at a moderate cost. For example, Professor Townsend, C.E., has supplied Belmullet with high-pressure water at a cost of only £1,000, exclusive of the cost of land and legal expenses. The reservoir consists chiefly of concrete. The water flows by gravitation through an iron main.

In collecting water for the purpose of having it analysed, care should be taken to secure a specimen likely to represent the average quality of the proposed supply. The centre of a river is the best part to take samples from. If the water of a river is proposed to be taken as a supply for a town, then that of every neighbouring stream entering it should be examined. In case the analysis of one or more of the tributary streams proved unfavourable, it might often be possible to either divert the streams or take water from the river at a point above the objectionable tributaries to it.

I have discovered the remarkable fact that good and bad water may co-exist in the one well—good hard water at the lower part, soft and bad water on the surface. Hence it is important that surface drainage, nearly always polluted, should be kept out of the openings of wells by having them covered, and the sides of the shafts cemented at least six feet downwards.

The organic matter in water may be wholly or partially

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derived from a vegetable source such as peat, the decomposing roots, &c., of plants in the soil, and their decaying leaves, &c., lying upon the surface of the ground. In countries where malarial fevers prevail, the presence of much vegetable matter in potable water is likely to produce disease in those who drink it; but in Ireland there is no evidence to show that organic matter altogether derived from peat, &c., is injurious to health. This question is of great interest in this country where peaty waters are so very common. Those waters have a yellowish or even brown hue, and are more frequently soft than hard.

Vegetable matter contains, on the whole, nearly 2 per cent. of nitrogen; when dissolved or suspended in water, a portion of this nitrogen is converted by fermentation into ammonia, which ultimately becomes oxidised into nitric acid. In the statement of the results of a water analysis, the amounts of albuminoid ammonia and saline ammonia are always mentioned, and sometimes the amount of nitrogen in the form of nitrous and nitric acids. The albuminoid ammonia does not actually exist in the water, but is formed in it by the analytical process—a better term, sometimes used, is albuminoid, or organic nitrogen. The greater the proportion of this ingredient the worse the water, for the presence of a large quantity of nitrogenous organic matter is dangerous, whilst practically no amount of actual ammonia or nitric acid is injurious. Nevertheless, we do not like to find much saline ammonia in a water, as it generally indicates the presence of sewage. In a peaty water the albuminoid ammonia is often twenty times more abundant than the saline; but when sewage is present, the saline ammonia usually exceeds in quantity the organic ammonia. It is easy to understand why this should be so. The peaty matter in water slowly decomposes, whilst the urea which is usually present in sewage, and contains 47 per cent. of nitrogen, speedily becomes carbonate of ammonium. I often meet with a peaty yellow water containing per Imperial gallon—

Albuminoid ammonia	...	...	0·020 grain.
Saline ammonia	...	...	0·001 „

whilst in a bright and sparkling water we may often have per gallon—

Albuminoid ammonia		...	0·008 grain.
Saline ammonia	...	...	0·012 „

I should much prefer to drink the former water, notwithstanding

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its flat flavour and yellow hue; for in the bright and colourless water the albuminoid matter would probably be derived from an animal source, and possibly contain the germs of a contagious disease.

In some waters large amounts of nitric acid are present. This is especially the case in the wells sunk in the carboniferous rocks. The nitric acid is generally derived from the oxidation of vegetable matter, and, but to a limited extent, from manure. By filtration throughout large masses of soil the water is purified from organic matters, but it contains the products of their decomposition. I prefer a water free from nitrates, and derived from untainted sources; but in certain districts we must tolerate the nitrates, if the water present no other objectionable features.

Chlorine, in the form of common salt, is present in water polluted by sewage, but it is often found in large proportions in really good water. The significance of chlorine has been much exaggerated. In hard and good water it is often present to the extent of from 4 to 10 grains per gallon. Frequently it exists as magnesium chloride or calcium chloride.

It is desirable that the amount of albuminoid ammonia should be less than 0·01 grain per gallon, and of saline ammonia less than 0·008. In the best waters the albuminoid and saline ammonia are low down in the third decimal place.

In 1881 there were in Ireland eleven cities and towns governed by Corporations, or Town Councils. Their aggregate population amounted to 683,502, and their valuation to £1,743,317. Their revenues amounted to £794,625.*

The nine townships surrounding the city of Dublin had a population of 95,400, a valuation of £390,667, and a revenue of £63,219.†

There were 92 cities and towns governed by Towns' Commissioners; their population amounted to 434,138; their valuation to £671,153;‡ and their annual revenue to £103,527.

The population of all these towns was therefore in 1881, 1,213,040, and their valuation for rating amounted to £2,805,137. In Irish towns the valuation is about two-thirds of the actual letting value.

I have endeavoured to ascertain the nature of the water

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* These figures (with some corrections) I have taken from Thoms' Directory for 1884, pages 668 to 670.

† Exclusive of Drumondia township, for which I have no return.

‡ Exclusive of Auchnacloy, Belturbet, Castleblayney, Cootehill, Fethard, Keady, Rathkeale, Tandragee. Their town revenues amounted in 1881 to £736.

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supplies to these 112 cities, towns, and townships. The following is a brief summary of the facts ascertained:—

The Eleven Towns Governed by Town Councils.

Belfast.—Population, 207,671; valuation £568,137. The water is almost wholly supplied from a reservoir, situated near Carrickfergus, about twelve miles from Belfast. The pressure is good, and the reports upon the quality made by Dr. Hodges, of Belfast, are satisfactory. It contains 12·6 grains of solid matters per gallon, and 0·11 part of albuminoid, and 0·07 part saline ammonia per million parts. These figures show that it is not equal to the Dublin pipe waters.

Clonmel.—Population, 10,519; valuation, £15,424. Supplied by local pumps and wells. I have from time to time examined a large number of specimens of the water used in this town. On the whole, they have not been of the quality suitable for domestic purposes. As a rule they were exceedingly hard, containing nearly 100 grains of solid matters per gallon. A few were highly polluted with sewage. The waters from Clonmel which I have lately analysed, were purer, probably because their sources were better protected from pollution. A town so large as Clonmel should be provided with a good supply of water, obtained from some of the neighbouring high grounds.

Cork.—Population, 78,361; valuation, £226,022. The supply of water is obtained from the River Lee, at a point about a mile above the city. Mr. O'Keefe's (Public Analyst for Cork) analysis of the water, made some years ago, did not give favourable results. He found that an imperial gallon contained—total solids, 5·57 grains, including albuminoid ammonia, 0·075 grain; saline ammonia, 0·04 grain; and chlorine, 0·661 grain. These figures indicate pollution. Since this analysis was made the waterworks have been improved, and the water is now filtered properly. Still, a water-supply from a river bordered by towns is not a desirable one. I think the sewage of Macroon enters the river at a point twenty-seven miles above the city of Cork.

Drogheda.—Population, 12,516; valuation, £28,121. This town is supplied partly with pressure water obtained from a Waterworks Company and partly by local pumps. The pipe water is collected at a gathering ground about two miles distance from the town, and stored in a reservoir. It is a fairly good water, but not equal to the pipe water of Glasgow and Dublin. It contains about 13 grains of solid matter per gallon, and from 0·005 to 0·01 of albuminoid ammonia, and somewhat smaller quantities of saline ammonia. In winter the supply is abundant,

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but in summer it is so scanty that the supply to the houses is limited to two hours daily. A small reservoir, situated one mile from the town, supplies two fountains. Sixteen of the local pumps are in possession of the Corporation. I have analysed the water yielded by all of them. They are mostly free from sewage; but the greater number are too hard for washing with, or, indeed, for any purpose save flushing sewers, &c. Perhaps the Corporation might see their way towards purchasing the waterworks and extending them. The water supplies of towns should always be under the management of the governing bodies thereof.

Dublin.—Population (of City), 249,486; valuation, £657,820. The gathering ground of the water supplied to Dublin consists of mountains, chiefly of the lower Cambrian formation, situated about 26 miles from the city, in the County of Wicklow. The reservoir is very large, and is capable of supplying 35 gallons per diem per unit of the population. At first the water impounded had a faint yellow colour, which gradually became deeper, and after three or four years became so deep as to excite alarm. The colour was caused by the peaty and other organic matter in the reservoir becoming soluble by fermentation. After a time the hue became less intense, and now the water is almost colourless. It is soft; one imperial gallon contains about 4·5 grains of solid matters, 0·005 grain of albuminoid ammonia, 0·0008 grain of saline ammonia, faint traces of nitrates and nitrites, and 0·96 grain of chlorine. Its hardness is about 1·8°, of which 0·8 is permanent. It is one of the purest waters in the world. With respect to pressure and quantity, the citizens have nothing to complain of. The cost of the work was £640,682 10s. 2d., up to 1884.

There are some well waters still used in Dublin. They are generally very hard, owing to the presence of large quantities of earthy salts. I have often found in Dublin pump waters from 50 to 75 grains of calcium sulphate per gallon. I consider most of these waters unfit for use, but there are some exceptions, notably the pump water in the Bank of Ireland. This water has the following composition per gallon :—

	Grains.
Total solid matters	24·500
Including	
Albuminoid ammonia	0·004
Saline ammonia	0·003
Nitrogen in nitrates and nitrites	0·090
Calcium sulphate	4·420
Chlorine	2·491
Oxygen required to oxidize organic matter...	0·208
Hardness	1·8°

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Kilkenny.—Population, 12,182; valuation, £33,155. This city is supplied by local wells, and, also to a limited extent, from a river. I have analysed, I think, the water from all the public and from many of the private pumps. There is no pressure water. The water from the wells is exceedingly hard, owing to the presence of lime and magnesia salts. They contain from 50 to more than 100 grains of solids per gallon. The majority are free from actual sewage; but as a rule they contain extremely large quantities of nitric acid—a product of the decomposition of nitrogenous organic matter. The sources of the water are, as a rule, tainted; but the water as taken from the wells is in general so well filtered by passage through a calcareous soil that it is generally very free from organic matter. Some are, however, more or less polluted. Kilkenny is one of the Irish towns which most urgently require a good water supply.

Limerick.—Population, 38,600; valuation, £65,547. This city is supplied with pipe water taken from the river Shannon, about 1½ miles distant from the city. For many years the quality of the water has been complained of, owing chiefly to its great turbidity, for the water was not filtered. The Corporation have recently purchased the waterworks from a Company. It may be that the water supply to the city will still be taken from the Shannon, but I am of opinion that a better quality of water is procurable in sufficient quantities from drainage areas in the high grounds not very distant from the city. I have analysed several samples of water proposed to be supplied to Limerick, and consider them much superior to the Shannon water. Many of the local wells are still in use, but as a rule they furnish impure water.

Londonderry.—Population, 28,947; valuation, £74,595. High-pressure water is supplied from reservoirs situated outside the city. The quantity is insufficient for a constant service, but the Corporation propose to procure an increased supply. Prof. Leebody's analysis shows that the water is of good quality. It is soft, containing 9½ grains of solids per gallon. It is delivered unfiltered.

Sligo.—Population, 10,764; valuation, £18,619. This town will soon be supplied with pressure water of good quality and soft, taken from a reservoir situated five miles from the town. Estimated cost of the work, £28,000.

Waterford.—Population, 22,401; valuation, £39,866. Until very recently this city was wholly dependant upon local pumps, the water from which was, with few exceptions, of extremely bad quality. The worst water which I have, I think, ever analysed came from a largely used public pump in this city.

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This water contained per gallon in grains—

Solid matters	385·8
Including	
Albuminoid ammonia	0·4
Saline ammonia	1·5
Sodium chloride	76·0
Calcium sulphate	34·0

The amount of ammonia in this water exceeded that often present in sewage.

A few years ago a new supply of water was obtained by impounding the drainage of a hilly region at Knockaderry, ten miles from the city. The water proved to be extremely brown in colour, which circumstance created great dissatisfaction amongst a large section of the citizens, some of whom refused to use the water. I predicted that in the course of a few years the hue of the water would be much less deep. The last specimen sent to me for examination, though still somewhat coloured, was comparatively pale as compared with the specimens sent to me three or four years ago. The citizens now seem satisfied with the water. The cost of the waterworks, &c., was £77,000.

Wexford.—Population, 12,055; valuation, £16,011. I have analysed several specimens of pump water used in this town. The majority were soft and fairly good, but several were hard and bad. One contained 95·2 grains of solid matter per gallon. A high-pressure supply of good water was lately procured. The waterworks have cost £30,000.

The Dublin Townships.

These districts are, with the exception of a very small portion of their area and exclusive of Rathmines, supplied with the Vartry pipe water (the same as that furnished to Dublin). Rathmines township is at present supplied with water from a canal. It is hard and of somewhat doubtful purity. The township will, however, soon be supplied with soft and remarkably pure water collected from the Dublin mountains.

The 92 Towns under Towns Commissioners.

Antrim.—Population, 1,647; valuation, £3,554. Supplied with pump water of, it is believed, good quality and palatable. The "Six Mile" river which flows past the town supplies water for various purposes.

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Ardee.—Population, 2,622; valuation, £4,060. The water is derived from pumps and wells. The quality is believed to be fairly good, but no analyses of it have I believe been made.

Armagh.—Population, 10,070; valuation, £16,925. A high-pressure supply from a small lake two and a half miles from the city was procured some time ago. It is rather peaty, and when in summer the lake falls considerably, the colour is somewhat high. On the whole, however, the water supply of this city is fairly good.

Athlone.—Population, 6,755; valuation £9,671. This town is supplied with water from the Shannon, which flows through it. There are seven pumps attached to wells. The water supplies are on the whole fairly good.

Athy.—Population, 4,181; valuation, £5,680. I have examined a great number of the well waters, which furnish exclusively the supply of this town. About one-third were very much polluted, and the rest were first or second class waters. Some of the pump waters in this town contain about 100 grains of solids per gallon. This town requires an improved water supply.

Auchnacloy.—Population, 1,333; town revenue, £77. The town is supplied by wells, one of which is much used by the poorer inhabitants, though the water is impure.

Bagenalstown.—Population, 2,141; valuation, £3,414. The supply of water is from local wells and a river. Some of the well waters are fairly good, others are of indifferent quality. Some of the water is filtered.

Balbriggan.—Population, 2,443; valuation, £4,014. The water is derived from wells and pumps. It is far too hard for potable purposes, and in some instances it is otherwise impure.

Ballina.—Population, 5,760; valuation, £8,154. This town will soon be supplied with high-pressure and good water from Loch Brohly, six miles distant. Prof. Townsend, C.E., informs me that the contract for executing the works was £8,556; this was exclusive of law costs. The supply will be 20 gallons per head.

Ballinasloe.—Population, 4,772; valuation, £8,740. The town is supplied wholly from local wells, some of which yield an inferior water.

Ballybay.—Population, 1,654; town revenue, £142. This town has an insufficient supply of water, which, moreover, is of very bad quality. It is derived chiefly from wells; but a small river yields water which is much used, though it is known to be highly polluted.

Ballymena.—Population, 8,883; valuation, £21,423. I have analysed twenty-one of the well waters of this town; with some exceptions they proved to be hard and fairly good. One of

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these waters contained 137·9 grains of solid matters per gallon, including the enormous quantity of 37·64 grains of nitric acid. Another contained 136·5 grains of solids, including 19·11 grains of nitric acid. An improved water supply from a distance of about seven miles is now being procured at a cost of £23,000.

Ballymoney.—Population, 3,049; valuation, £6,034. The supply is taken from local pumps, and is deficient in both quality and quantity. But a good high pressure water will soon be supplied to all the houses in the town at a cost of £6,000.

Ballyshannon.—Population, 2,840; valuation, £4,022. The supply is from pumps and wells. I have analysed only one water from this town, and it proved to be a good one; but the inhabitants are disatisfied with their water supply, and the question of improving it has lately been considered.

Banbridge.—Population, 5,609; valuation, £12,716. I have examined about 40 well waters used in this town. Most of them are very hard, and several are polluted with sewage. This town urgently requires an improved water.

Bandon.—Population, 5,945; valuation, 9,621; town revenue (1881), £1,890. Supplied by wells and pumps. One of the waters which I examined was hard, but otherwise good. A scheme for supplying the town with high-pressure water is now under consideration, and the proposed water is being analysed in my laboratory.

Bangor.—Population, 3,006; valuation, £10,287. Works to supply high-pressure water are nearly completed. They will cost about £10,000. I have analysed the water proposed to be used, and have found it to be of good quality. I have found the pump waters of this town to be superior to average well waters.

Belturbet.—Population, 1,807; town revenue, £375. The river Erne and three pumps furnish the water. One of the pumps yields a supply of very doubtful quality.

Boyle.—Population, 2,994; valuation, £3,847. The town is supplied with well waters only. Those that I have analysed proved to be fairly good.

Bray.—Population, 6,535; valuation, £24,503. This town is supplied with good high-pressure water.

Callan.—Population, 2,340; valuation, £2,002. Supplied by local pumps, some of which are of doubtful quality.

Carlow.—Population, 7,185; valuation, £11,157. The town depends upon local wells for its supplies. I have analysed many of the waters used in this town, and, on the whole, have an unfavourable opinion of them. Many of them contain from 70 to 112 grains of solids per gallon, including from seventeen to

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twenty-two grains of nitric acid. The rise of the River Barrow appears to affect the quality of the Carlow well waters. The town urgently needs a good supply of high pressure water.

Carrickfergus.—Population, 10,009; valuation, £5,561; revenue, £1,275. The town is supplied with good water from reservoirs, situated one and a half miles from the town.

Carrickmacross.—Population, 2,002; valuation, £2,893. This town is supplied by well waters, several of which I have analysed and found to be impure.

Carrick-on-Suir.—Population, 6,583; valuation, £8,836. This town has no pressure water. Some of the well-waters which I have examined are of good quality.

Cashel.—Population, 3,961; valuation, £5,695. A good supply of pure water of high-pressure is obtained from the neighbouring hills; it is filtered before being delivered to the city, for this small but ancient place is entitled to the rank of city.

Castlebar.—Population, 3,855; valuation, £4,132. The town depends upon wells and pumps; the water from them is, as usual in such towns, not alogether pure.

Castleblayney.—Population, 1,810; town revenue, £100. Supplied by local wells and pumps. The water is believed to be fairly good.

Cavan.—Population, 3,050; valuation, £5,155. The results of analyses of fifteen of the pump waters in this town enable me to state that Cavan is one of the towns in this country most urgently requiring good water. There are hills not far distant from which supplies might be procured.

Clonakilty.—Population, 3,676; valuation, £4,824. Supply of good water, gathered from neighbouring hills, is delivered under pressure to the town.

Clones.—Population, 2,216; valuation, £3,356. The supply is chiefly from five public pumps, two of which are adjacent to and below the level of church-yards. The Local Sanitary Authority (the Board of Guardians) has hitherto not complied with the oft expressed request of the Town Commissioners for a more abundant and purer supply of water.

Coleraine.—Population 5,899; valuation, £12,805. This town is supplied with water collected from springs situated about three miles distant. It is conveyed direct from the springs, and has a considerable degree of pressure. In case of a contingency water may be also obtained from a small reservoir which contains sufficient for fourteen days' supply. Fifty gallons per head is the quantity delivered. The water contains 11⅓ grains of solids per gallon, and is very free from organic matter. I have analysed two specimens of pump water from this town and found

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them to be of good quality. The waterworks of this town have cost £9,600.

Cookstown.—Population, 3,870; valuation, £6,187; town revenue £189. This town has no high-pressure water. Fifteen public and several private pumps supply water, concerning which local opinion is much divided. Some of the townspeople are satisfied with its quality; others considered it for the most part impure. In 1876 seven of the waters used in this town were submitted to me for analysis. I found that they were free from sewage. The total solids varied from 8 to 45 grains per gallon. Professor Hodges has, however, found impurities in some of the pump waters. Some of the waters which I have examined are undoubtedly too hard. The subject of obtaining a supply of good high-pressure water has long been discussed. A scheme for this purpose was proposed in 1876 by Mr. J. F. Mackinnon. He proposed to take water from Loughbrackin, a distance of seven and a half miles. The cost was estimated at £8,430. He proposed another scheme for taking water from Mountober Springs, situated four and a half miles from the town. This scheme, which involves the construction of a reservoir, would cost as estimated £12,500.

Cootehill.—Population, 1,789; town revenue, £152. The town commissioners have control of five pumps which supply, very inadequately, the wants of the town. Many private wells and some small streams are brought into requisition to make up the deficiency. Some of the pump waters are very inferior, and the town ought to be provided with a good and sufficient supply.

Downpatrick.—Population, 3,419; valuation, £8,001. Some of the pump waters in this town are exceedingly hard, and some are impure.

For several years past the Downpatrick Board of Guardians have been discussing schemes for supplying the town with pure water, but though much expense has been incurred by them in commissions, &c., the supply is still wanting.

Dromore.—Population, 2,491; valuation, £4,363. I have lately analysed nine waters from the public supplies in this town. Several of them were very hard and impure, and most of the others were second-class waters.

Dundalk.—Population, 11,913; valuation, £20,692. The pump waters in this town are on the whole of very inferior quality; a good supply of almost colourless water will, however, soon be procured from neighbouring hills. It is one of the purest waters that I have ever examined. A loan of £26,000 for waterworks has been secured.

Dungannon.—Population, 4,084; valuation, £8,114. A high-

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pressure supply is procured from a distance of seven and a half miles at a cost of £13,500. It is of good quality.

Dungarvan.—Population, 6,306; valuation, £8,265. All the pump waters sent to me from Dungarvan prove to be free from pollution.

Ennis.—Population, 6,307; valuation, £6,944. The well waters in this town are, as a rule, very impure. One of the town pumps was closed by order of the magistrates some time ago, on the application of the local authorities. My analysis proved that the water was largely composed of sewage. Ennis has lately been supplied with pressure water from a neighbouring reservoir connected with a lake. The cost of this improvement has been £11,000. It is slightly peaty, but good in all other respects.

Enniskillen (population, 5,712; valuation, £11,714) is supplied with high-pressure water, taken from Lough Erne at a point distant four and a half miles from the town. The lake has an area of 36,923 acres, and its waters ought to be pretty pure, but as supplied to the workhouse I found it rather yellow. It contained 7·7 grains of solids per gallon. The pump waters of Enniskillen are not, as a rule, very good. The water rate is 6d. in the pound on the Poor-law valuation.

Fermoy (population, 6,454; valuation, £9,931) will soon be supplied with good high-pressure water from a reservoir situated three and a half miles from the town. The works will be completed at a cost of £13,000.

Fethard (population 1,926; town revenue, £168) is supplied by four public and several private pumps. One of the pumps yielded water which I found to be very impure.

Galway.—Population, 15,597; valuation, £26,240. High-pressure water is supplied from the river Corrib, which discharges the waters of a large lake—Lough Corrib—into the sea. The water contains about 11 grains of solids per gallon, 0·008 grain of albuminoid ammonia, 0·002 grain of saline ammonia, and 1·4 grain of chlorine. Hardness 7°. It is, therefore, a fairly good water, but not equal in colour or purity to the Dublin pipe water. The pump waters in Galway are all hard, from presence of lime and magnesia salts, and some of them are somewhat impure.

Gilford.—Population, 1,324; valuation, £1,834. Supplied by local wells, the water of which is pretty good.

Gorey (population, 2,450; valuation, £3,148) is supplied with high-pressure water of good quality, but, so far as 1884 is concerned, deficient in quantity. One spring supplies a reservoir, and water from other springs is conveyed direct to the town.

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Holywood.—Population, 3,293; valuation, £12,480. This town was, in 1883, supplied with water collected at a distance and delivered to the town under pressure. My analysis shows that it contains 14 grains of solid matter per gallon, including 0·005 grain of albuminoid ammonia; saline ammonia, 0·006; nitrogen in nitrites and nitrates, 0·015 grain; chlorine, 1·886. The water is nearly colourless. Cost of the waterworks, £10,000.

Keady.—Population, 1,598; town revenue, £253. The public fountains and some of the houses are supplied with high-pressure water from a reservoir in connection with Clea lake. Dr. Allen, Chairman of the Town Commissioners, informs me that some of the well waters still used are scarcely fit for potable purposes. Several of the wells dried up this year.

Kells.—Population, 2,822; valuation, £3,508. The water is derived from pumps and wells. It is mostly very hard, and some of it impure.

Killarney.—Population, 6,651; valuation, £4,928. Many of the pump waters in Killarney are soft and pretty good, but several are very impure. A supply of good soft water will soon be collected from a stream from neighbouring hills and stored in a tank. The cost is estimated at £8,000.

Kinsale.—Population, 5,386; valuation, £5,454. I have examined a pretty fair specimen of water for the Kinsale Harbour Commissioners. This is all the knowledge which I possess of the water supplies of this town.

Larne.—Population, 4,716; valuation, £4,782. This town has just been furnished with a supply of water from the "Sallagh" Springs, situated on elevated ground three and a half miles from the town. The water is good and abundant. There is a tank, but the water in it is intended to be used only in case of fire.

Letterkenny (population, 2,188; valuation, £3,215) was long dependent upon the scanty and impure supplies of water furnished by local wells, but now it has abundance of good water, obtained from a distance. The main reservoir is one mile from the town.

Limavady (population, 2,954; valuation, £5,795) is supplied with high-pressure water from a tank having a capacity of 135,000 gallons. The water is good, and is collected from springs. The works will cost £6,000.

Lisburn.—Population, 10,753; valuation, £18,751. The greater part of the town is supplied with pressure-water from a reservoir one mile distant. Its composition, according to Dr. Hodges, is as follows:—Total solids, 12·6 grains per gallon; albuminoid ammonia, 0·199 parts per million; saline ammonia,

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0·055 parts per million. The quantity of albuminoid ammonia appears to be excessive. In the outskirts of the town the people depend upon wells.

Lismore.—Population, 1,860; valuation, £2,212. Is supplied with high-pressure water brought direct from springs in the clay slate rocks, lying north of the Blackwater. The water is very good, but in summer it is occasionally deficient, and fails to supply the houses in the higher parts of the town. The supply is usually turned off at night. Lismore, therefore, requires an improved water supply.

Longford.—Population, 3,590; valuation, £7,029. I have analysed several of the pump waters, and found the greater number to be impure.

Loughrea.—Population, 3,072; valuation, 3,665. The water used is chiefly taken from a neighbouring lake, and is delivered with some degree of pressure into many of the houses. My analysis of the water as supplied to the town shewed that it had in some way become somewhat polluted. The water supply to Loughrea requires investigation. The water is pumped by turbines into a tank, having a capacity of 118,000 gallons; the cost of the works was £3,370.

Lurgan.—Population, 10,135; valuation, £18,348. The water used in this town is derived from public pumps and private wells. Its quality varies considerably; several specimens which I analysed proved to be impure; one contained 113 grains of solids per gallon.

Mallow (population, 4,439; valuation, £6,478) is famous for its springs and spas; yet in some parts of the town the pump waters are very impure. When Asiatic Cholera visited this town it was in the quarters where the impure water was used that the disease was most prevalent. The town is supplied with pressure water from a reservoir at a cost of £6,250.

Maryborough.—Population, 2,872; valuation, £3,869. The water, derived from wells and pumps, is extremely hard, but generally free from sewage impurities.

Middleton.—Population, 3,358; valuation, £5,675. The waters in use in this town are deficient in quality and quantity. The Board of Guardians have undertaken to supply the town with pure water.

Monaghan.—Population, 3,369; valuation, £5,967. Nine public pumps and numerous private wells and pumps supply water to the inhabitants. Some of the wells are 50 feet deep. In most cases the water is pure.

Mountmellick.—Population, 3,126; valuation, £4,052. Excessive hardness is the characteristic of the well waters which supply this town. Although some of them are free from pollu-

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tion, others are not so, and on the whole I think Mountmellick requires an improved water supply.

Mullingar.—Population, 4,787; valuation, £7,541. I have examined a large number of the pump waters which supply this town. Some of them are fairly good, but others are hard and bad. In one I found 137 grains of solid matters per gallon, including the very high proportion of 0·05 grain of albuminoid ammonia.

Naas—Population, 3,808; valuation, £7,612. Depends altogether upon local wells and pumps, many of which I have found to be very impure.

Navan.—Population, 3,873; valuation, £5,660. The town depends altogether upon supplies from local sources, which have no pressure. There are nine public pumps and many public and private wells, including a so-called spa. Some of these waters are good though somewhat hard for detergent purposes, others are of indifferent quality; in one I found 119 grains of solid matters.

The following are analyses of the water of the river Boyne, taken above the town, and of the Blackwater, taken in the town. One imperial gallon (70,000 grains) of each contains—

	Boyne. grains.	Blackwater. grains.
Total solid matters	19·600 ...	13·300
Including		
Albuminoid ammonia ...	0·012 ...	0·012
Saline ammonia	0·002 ...	0·002
Nitrogen acids...	traces ...	traces
Chlorine	0·980 ...	0·985

The Blackwater, filtered, would furnish a better quality of water to Navan than it obtains from the local wells.

Newbridge.—Population, 3,372; valuation, £4,325. The pump waters which supply this town are exceedingly hard. In four of them I found more than 200 grains of solid matters per gallon. They are, however, pretty free from actual sewage matter.

New Ross.—Population, 6,670; valuation, £8,039. Four conduits convey water from springs situated in the higher portion of the town, and delivered with some degree of pressure to the lower portions of the town. In 1877 I found the water from the principal tank was fairly but not very good. There are six public pumps which also supply water to the town, their quality is variable; as a rule the New Ross waters are pretty soft.

Newry.—Population, 15,096; valuation, £32,450. This im-

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portant town is supplied with water taken from the Lake of Camlough, which covers an area of 160 acres, and is situated at a distance of four miles from the town. 650,000 gallons are delivered at a very high pressure, and the great majority of the houses have the water laid on to their interiors. There are numerous street fountains for the use of the poorer classes. The composition of the water is somewhat variable, but on the average it contains about eleven grains of solid matters, and very moderate amounts of albuminoid and saline ammonia. Newry is, therefore, one of the few towns in Ireland provided with really good and abundant water.

Nenagh (population, 5,422; valuation, £8,312) is altogether supplied by well and pump waters. I have not examined many of them, but the few which have come under my observation have been pretty good.

Newtownards.—Population, 8,676; valuation, £10,005. I have made a very large number of analyses of the water used in this town. Twenty-two of the pump and well waters were analysed in 1877; of these seven were unfit for use, and some of the others were second-class. The solids in solution varied in amount from 15·4 to 91 grains per gallon. Eighteen specimens analysed in 1881 were of better quality, their worst features being excessive hardness, and the presence of much nitric acid. Three pump waters examined in 1882 were fairly good.

Omagh.—Population, 9,755; valuation, £6,251. Pressure water is supplied to this town. Its composition I found, in 1882, to be as follows:—

One Imperial gallon contained—

Total solid matters	4·900 grains.
Including—	
Albuminoid Ammonia ...	0·006.
Saline Ammonia	0·004.
Nitrogen Acids	traces.
Chlorine	1·415.

The water is derived from a reservoir two and a half miles distant from the town. Amount of waterworks loan, £12,115.

Parsonstown.—Population, 4,126; valuation, £8,712. Has only pumps and open wells to procure water from. These waters are very hard. Some of them are free from organic impurities; others are polluted. In one I found 111·15 grains of solids per gallon.

Portadown.—Population, 4,955; valuation, £17,066. Supplied by local wells. In one of their waters I found 114 grains

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of solids and 30 grains of chlorine. It was, however, free from sewage; others examined by Dr. Hodges and the late Mr. Whitla were, with one exception, found to be pretty good.

Queenstown.—Population, 9,755; valuation, £19,908. This town has just secured an excellent supply of water from a distance of about eight miles, and at a cost of about £20,000. I have analysed the water, and found it to be very pure.

Rathkeale (Population, 2,549; revenue, £192) is supplied with pump water only, which on the whole appears to be of fairly good quality.

Roscommon.—Population, 2,117; valuation, £2,880. Supplied only by pumps, the water from which is pretty good.

Strabane. — Population, 4,196; valuation, £9,187. Has a high-pressure supply, but the quantity is most defective, the town may be said to be really badly off for water.

Skibbereen.—Population, 3,631; valuation, £4,699. The springs and wells which supply this town are deficient in quantity, and some of them in quality, during the recent hot weather the springs almost disappeared. The Board of Guardians—the Sanitary Authority—have undertaken to improve the water supply of this town, but up to the present have not realised their promises.

Tanderagee.—Population, 1,592; town revenue, £56. Four water pumps supply this town. I have analysed three of them: 1 was bad, 1 good, and 1 indifferent.

Templemore.—Population, 2,800; valuation, £3,886. Has a rather scanty supply, of indifferent quality of pump and well waters.

Thurles.—Population, 4,850; valuation, £6,107. Local wells supply the water used for potable purposes, and for other purposes the River Suir is made available. One of the well waters sent to me for analysis in June last was very hard (105 grains solids per gallon), one was slightly polluted, and another specimen was found to be pure.

Tipperary. — Population, 7,274; valuation, £8,663. The town is supplied by a spring termed the Church Well (which has not failed during the recent drought) and several public and private pumps and wells. Several of the waters are very hard; one contains 137·9 grains of solids per gallon, and is somewhat impure. Yet on the whole this town is pretty well supplied with water, which, however, has the disadvantage of not being delivered under pressure. The water used in the barracks was analysed in 1877 at Netley, by Prof. De Chaumont, and found to be "usable."

Tralee.—Population, 9,910; valuation, £12,303. The well waters of this town are generally unfit for use. I have analysed

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about 30 of them. Some contain from 100 to 200 grains of solid matters per gallon. Recently a supply of water from a tank situated 4½ miles from the town has been procured, and it has been conveyed under high pressure into many of the houses in the principal streets.

The composition of this water, according to my analysis, is as follows. I give it as an example of really good water:—

One imperial gallon (70,000 grains) contains:

Dissolved.	Grains.
Lime	0·24
Magnesia	0·11
Potash and soda	0·69
Oxide of iron, silica, &c.	0·28
Chlorine	0·68
* Organic and volatile matters	2·50
Total solid matters per gallon ...	4·00
* Including organic nitrogen	0·004
" ammonia	0·002
Nitric acid	Faint trace
Nitrous acid	None

Matters Suspended in the Water.	
Organic and volatile (at a red heat)	0·55
Fixed solids	·17
Total suspended matters	·72

One gallon of this water, therefore, contains, of solid substances:

	Grains.
Suspended matters	0·72
Dissolved matters	4·00
Total solid matters	4·72

Of the solid substances 0·86 grain is precipitated by boiling a gallon of the water for ten minutes.

Trim.—Population, 1,586; valuation, £2,115. The town has no pressure water. Many of the pump and well waters are impure, two of the public pumps were closed by order of the sanitary authorities, my analysis having shown that they were unfit for use.

Trim has, for a small town, a very large revenue, namely,

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about £800 a year. Good water is procurable from springs situated near the town. There would, therefore, seem to be no good reason why this town should not be supplied with pure water.

Tuam (population, 4,223; valuation, £4,035) is supplied by pumps and wells, and their waters are "good, bad, and indifferent," as is usually the case in such towns. In a water sent to me from this town by Mr. French, solicitor, there were 164 grains of solids per gallon, and in other respects the water was bad.

Tullamore.—Population, 5,098; valuation, £5,392. The water supply is derived from five public pumps, and from private pumps and wells. It is generally very hard, but on the whole free from pollution.

Westport.—Population, 4,469; valuation, £6,243. The town is supplied by wells and pumps. Their waters are generally somewhat peaty, but free from sewage.

Wicklow.—Population, 3,391; town revenue, £1,361. The majority of the pump waters in this town are impure or second class. A pressure supply has lately been procured. The reservoir is about one mile from the town. The water is of good quality though somewhat high in colour, but no doubt, as in similar cases, the colour will in time become less intense. The waterworks cost about £6,000.

Youghal.—Population, 5,936; valuation £9,571; town revenue, £2,144. Four public pumps and several private wells supply the inhabitants with water. The quality is locally believed to be good. I have not seen any analyses of Youghal waters.

In concluding these brief notices of the supplies of water to Irish towns, I have to point out that, as a rule, they are of defective quality, and that in the great majority of cases the towns of Ireland have no high-pressure water, which is so useful in the case of fires and for other purposes. The Metropolitan area and eight of the towns governed by Corporations have high-pressure water supply, but very many of the 94 smaller towns are dependent upon local wells, &c., which, on the whole, furnish impure supplies.

[*For discussion on this Paper see page* 389.]

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On "The Supply of Pure Water to Villages and Country Residences in Ireland," by Prof. HULL, LL.D., F.R.S.

The importance, in relation to health, of pure water for domestic use, though generally recognised in theory, is often neglected in practice. To the existence of an impure water supply may often be traced the outbreak of typhoid or other zymotic fevers in villages and country houses, which might be supposed to be safe against the attacks of this and similar unwelcome visitants. Where cholera is prevalent, contaminated water is a prime cause of attack. Large towns are really in a better position as regards pure water-supply than villages and country houses, as, under the Public Health Act of 1872, the corporate bodies and sanitary boards have powers and means for procuring proper supplies of pure water which do not exist in the case of humbler and smaller centres of habitation. The City of Dublin, notwithstanding many disadvantages as regards its sanitary arrangements, possesses at least the inestimable blessing of abundance of pure water.

Some years ago I ventured to read a paper at a meeting of the British Association, at Bristol,* on the subject of the water-supply for villages and hamlets in England; in which I pointed out that, owing to the geological structure of the central and southern portion of that country, villages and hamlets now improperly supplied, might, by a system of deep wells, have pure water made available through local effort similar to that of the School Board system. The peculiarity of the geological structure of that country, on which I founded my proposals, lies in the alternation, or succession, of permeable and impermeable strata over very large areas; the permeable strata being water-bearing, the impermeable not so, or only to a slight extent. These proposals received the approval of the then President of the Local Government Board, Mr. Sclater-Booth, but have not as yet been acted upon. The principal water-bearing formations of England are the Chalk, the Oolitic limestones and sandstones, the New Red Sandstone, and the Permian formations.†

It is to be regretted that this country is not so favourably

* "A Scheme of Water-supply for Villages, Hamlets, and Country Parishes of the Central and Eastern Counties."—*Quarterly Journal of Science*, July, 1876.

† See also on this subject De Rance's work on the "Water-supply of England and Wales." (Stanford, London.)

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circumstanced for local water-supply from deep wells as England. The formations of which it is composed throughout almost the whole of its area are of older date than those which in England afford the largest and most reliable supplies, such as the New Red Sandstone and Cretaceous beds*—they are harder, less absorbent, and less porous in structure; and consequently do not imbibe the quantity of rainfall that softer, and more porous, strata are capable of doing.

The great Carboniferous limestone formation, which occupies an area of one-half the surface of the country, is doubtless water-bearing in *this* respect:—that the rain passes down into, and through, it by means of fissures and joints; but it is not of the porous nature of the Chalk, which absorbs into its own mass a quantity of water equal to at least half the annual rainfall. Hence it is that sinking for water by means of wells in the Carboniferous limestone becomes an uncertain undertaking, as its success will depend on the well (or other perforation) striking a water-bearing joint or fissure. The same may be said of the Silurian and Granite Rocks, which are largely distributed along the east of Ireland, as may be seen by reference to a geological map.†

Thanks, however, to the abundant rainfall and to these same characteristics of the strata, springs are numerous, especially in hill districts; and if proper investigations are carried out, in most cases it will be found that, one or more springs of water are within reach of any special village or country residence, which only require to be tracked up to their source and conducted by closed pipes to the place of supply. Much detriment to health may arise from the use of water which, originating in a pure spring, has been allowed to flow to the place of supply subject to contamination from decaying animal or vegetable matter along its course. Earthenware pipes, properly laid two or three feet below the surface, and set in cement, will suffice to carry the water intact when there is a slight fall all the way.

In many cases, however, wells become necessary, and special precautions are required in order to obtain satisfactory results. In England, where the New Red Sandstone or Chalk formations prevail, wells for the supply of villages or private houses are often sunk to considerable depths, varying from 150 to 200 feet, or even more. In such cases they have to be carried down below the underground water-level, and draw their supplies from the internal reservoirs. Such wells always afford pure

* Some large and deep wells in these formations yield from one to two millions of gallons per day, raised by powerful pumping machinery. They are at work in Liverpool, St. Helens, Nottingham, Birmingham, &c.

† See appendix.

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and wholesome water; because, being derived from the rainfall, it has necessarily percolated through a considerable thickness of rock, which acts as a natural filter for eliminating surface impurities. Such wells, however, are rare in this country. As far as my information goes, *deep wells* are almost unknown amongst villages and country houses, and supplies are generally drawn from shallow wells, small surface streams, or ditches.

This seems a fitting occasion to call attention to the danger to health which arises from the use of water from such sources. Water which comes from surface-drainage is liable to contamination from various causes, amongst which may be mentioned the manure used for agricultural purposes. Vegetable and animal matter is constantly decaying at the surface, and is liable to be taken up by surface streams. Therefore, it follows that, where pure spring water cannot be had, deep wells should be sunk for domestic use.

The Post-Tertiary, or glacial deposits which occupy a very large proportion of the surface of this country—offer facilities for supply from wells. These deposits are permeable; and consist of sand, gravel, silt, and stony clay. Of such deposits a very large part of the central plain of Ireland, as well as the valleys and plains of other parts, are formed; extending below the peat-bogs, or overspreading the surface where bogs do not exist. Wells sunk in these deposits are likely to yield wholesome water, but under the following necessary conditions:—

1. They should be of sufficient depth, not less than 35 or 40 feet; better if more.

2. The surface-drainage ought in all cases to be stopped off. This can be done by lining the well with brick or solid masonry, properly cemented, to a depth of about ten feet, below which the well need only be lined with rubble.

3. In no case should the well be sunk in a farmyard, or near a cesspool or manure heap; nor should it be in such a position that it would receive the water percolating from any source of contamination of this kind. Even a water-tight lining such as that above described might in such cases prove insufficient to keep the water pure.

Such precautions will probably suffice to preserve the water free from organic contamination in rural or thinly-populated districts. Any one who is in the habit of visiting country places will be aware how generally these precautions are neglected;—or ignored. Still, when stated, they will probably be accepted as reasonable, or self-evident.

All authorities are now agreed that the questions of drainage, ventilation, and water-supply, when properly understood, and

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acted upon, are the bases of sanitary reform. Such associations as the present, aided by the public press, are doing a good work in extending a knowledge of these subjects amongst the people; but much depends on individual effort in diffusing, as opportunity may offer, a knowledge of the principles of sanitary science.

The restricted limits necessarily assigned by the rules of the Congress to papers read before the sections, have obliged me to curtail my observations on the topic here dealt with. But my object will have been attained, if I have succeeded in calling the attention of those resident in country places to a source of disease which those who are acquainted with Irish villages and country residences must admit to be generally overlooked.

The accompanying table will show the succession of water-bearing formations (properly so called), which are absent, or but slightly represented, in Ireland, though largely distributed over England.

APPENDIX.

Water-bearing formations of England and Ireland.

[NOTE.—The term "Water-bearing" is here used to designate only those formations of a porous nature, through which water from the surface easily percolates, and settles in the form of an internal reservoir capable of being drawn upon by wells.]

ENGLAND. (*Water-bearing Beds.*)	IRELAND (*Water-bearing Beds.*)
Post-Tertiary Deposits, sand, gravel, and loam, &c.	Present.
Lower Tertiary, sand & gravel beds (Woolwich & Reading Bed.)	Absent.
Chalk-limestone.	Absent, except in the N.E.
Upper greensand.	Very slightly represented in the N.E.
Lower greensand.	Absent.
Purbeck and Portland Beds.	"
Coral rag and grit.	"

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ENGLAND—(*con*). (*Water-bearing Beds.*)	IRELAND—(*con*). (*Water-bearing Beds.*)
Great oolite.	Absent.
Inferior oolite, &c.	"
Upper lias sands.	"
Marlstone or middle lias.	"
Lower Kemper sandstone (Waterstones.)	"
New red sandstone (Bunter.)	Present only in the N.E.
Permian sandstones.	Only traces.
Carboniferous sandstones and grit.	Present.
Devono-silurian or Dingle Beds (Lower old red sandstones.	"

Below the above are the older palæozoic or primary formations, which are not water-bearing in the sense here used, but give forth water from fissures by means of springs.

[*For discussion on this Paper see page* 389.]

On "The Rainfall of Ireland," by G. J. SYMONS, F.R.S.

Observations upon the amount of rain falling at isolated stations in the British Isles have been made for more than two centuries, the earliest records still existing being those for Townley, near Burnley, in Lancashire, which commence with 1677. In Ireland it was more than a century later before any observations were made, or at any rate before any were made of which I possess the records. The first Irish series known to me is that made by Dr. Kirwan, F.R.S., at Cavendish Row, Dublin, commencing in 1791 and continued to 1808. His gauge was on a roof 30 feet above the ground, a position which is now known to be very undesirable; but the quantity collected at that height—viz., 22 inches (on the average of 19 years) is fairly consistent with the amount which would probably have been collected in a similar position during recent years. The fall on the ground at Dublin is far larger; probably 30 inches is the true mean rainfall of the capital.

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The habit of observing the fall of rain was slowly formed in Ireland; for, even half a century back, in 1834 there had been only six records commenced—viz. (in addition to Dr. Kirwan's):—

Linen Hall, Belfast.—Begun in 1796; stopped at the end of 1799; recommenced in 1812 and continued for many years.

Londonderry.—Begun in 1797, stopped in 1800.

Edgeworthstown.—Observations preserved only for 1798, 1807 and 1808.

Dublin.—Observations made by Mr. A. Semple in 1823 and 1824.

Markree, Sligo.—Observations commenced in 1833 and continued, with slight breaks, to the present time.

Even down to a quarter of a century back, when I began the collection and publication of rain records, the greatest number of stations which had ever been simultaneously at work in Ireland was only 16, against 135 in Scotland and 327 in England.

In the autumn of 1863 I applied to the British Association for a grant with which to purchase rain-gauges for gratuitous distribution, and by letters in the Irish newspapers and by other means I was enabled to obtain a large number of offers of assistance, so that on January 1st, 1864, I had the satisfaction of knowing that the number of stations at work in Ireland was double what it had ever been before. I continued my efforts to increase the number of stations in Ireland, and in 1871 had raised it to 67, or four times what it was when I began. Still, however, it was far below what was needed for meteorological and *à fortiori* for engineering purposes. Therefore when the British Association met at Belfast in 1875, Section G. (Engineering) recommended a further grant for rain-gauges in Ireland, and by the cordial co-operation of the Irish press, and especially by the kind help of Mr. C. Eason (Messrs. W. H. Smith and Son), of Dublin, and somewhat vigorous action on my own part, no fewer than 66 new stations were established, and the entire number was raised to 153.

If observers never died, and if I could place them over the country like the pieces on a chess-board, 150 stations would probably suffice, but of course death is constantly thinning our ranks, and besides that, there is a tendency towards a plethora in the more active intellectual centres and the reverse in the wilder mountainous districts. I shall therefore be very thankful for offers of help, especially in the western counties.

From the above it will be obvious that even now the material for determining the rainfall of some parts of Ireland is absent; still it is far better than it ever was before, and having just

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completed some calculations upon the subject, I have thought that it might be of interest to show first, in the capital of the country, the latest and most accurate representation of the fall of rain over the whole of Ireland. At the same time it must be distinctly understood that when Irish Engineers imitate their English brethren and keep records of the fall of that rain with which they have to deal, when Irish gentry, Irish clergy, and Irish gardeners take to the habits of their friends both north and south of the Tweed, a far better map may be produced.

The broad general features are easily remembered, viz., that most places within about 60 Irish miles (77 English miles) of the south or west coast have upwards of 40 inches of rain per annum, and that central, east and north-east Ireland have between 30 and 40 inches, Dublin being almost, if not absolutely, the driest place in Ireland.

The above are the general features. Mountains always act as condensers, and therefore the rainfall in parts of Wicklow and amid the Mourne Mountains, in County Down, is as great as on the west coast. Hence, in Ireland, as in England and in Scotland, beautiful scenery and heavy rainfall are inseparably connected; but it would be a terrible mistake for any one to lose the charming scenery of Wicklow, of Rosstrevor, or of Newcastle because there might be a shower; and the citizens of Dublin may indeed be doubly grateful for the heavy rain on the Wicklow Hills; first, because it furnishes them at an exceptionally small cost with the ample and excellent Vartry water supply; and secondly, because the dryness of Dublin is slightly increased by the action of those hills on the clouds before they reach the city.

The land within 60 Irish miles of the south and west coast has generally a rainfall between 40 and 50 inches, but this is also increased in mountainous districts. It is only quite recently that, after many efforts, I have succeeded in getting any returns from Killarney, but those now obtained show that a considerable area of Kerry has upwards of 60 inches; and a record kept in 1883 in the Gap of Dunloe and forwarded to me by the Rev. G. R. Wynne, gives the large total of 104·30 inches. As the fall in that part of Ireland last year was some 15 per cent. above the average, this observation indicates that the mean fall in the Gap of Dunloe is about 90 inches.

There is one Irish record which is at present a puzzle to me. In 1874 I sent a perfectly accurate gauge to Kylemore Castle, Clifden, in the extreme west of Galway. The observer has been changed more than once, and recently a new gauge of a slightly different pattern has been sent to a new observer, yet all the records are consistent in giving an enormous rainfall—

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about 80 or 90 inches. I have never been in the county myself, but I can see nothing in the position or configuration of the hills as shown on the maps which will explain so large a fall. I shall therefore be very glad if anyone will establish a second gauge in the neighbourhood, or in any way assist in explaining that which at present is rather an enigma.*

In conclusion, it may be well to mention why I urge so strongly that additional records of rainfall should be kept in Ireland. I do so chiefly on engineering grounds. The first thing that an engineer requires, is accurate knowledge of the quantities with which he has to deal, whether those quantities be wind force, weight of train, density of rock, length of span, or quantity of water. No gravitation water-works for a town can be economically laid out unless the engineer knows what quantity of rain usually falls on the gathering ground. No system of drainage will stand the test of years in which the maximum floods and the minimum dry weather flow have not been ascertained. So-called "accidents" to railway banks and culverts, and to town sewers, are generally traceable to imperfect knowledge, or insufficient consideration, of the amount and duration of rainfall.

Few things would please me more than to find an Irishman who would give the money, the patience, and the time requisite to work up the rainfall observations in Ireland: but until such a one is found, I will go steadily on relying upon the continued help of my present staff of 150 volunteer observers. Would that they were all here that I might thank them for their assistance!

[*For discussion on this Paper see p.* 389.]

On the Geology of the Neighbourhood of Dublin as affecting its Sanitary Conditions, by Rev. M. H. Close, M.A.

The city of Dublin is situated on the mouth of the River Liffey, at the head of Dublin Bay. The bay opens eastward; it is nearly seven miles in depth or recess, by nearly six miles

* [While attending this Congress I saw in a shop window a photograph of Kylemore Castle, and it shows that the ground rises very abruptly at the back of the castle, probably with sufficient abruptness to explain the large amounts hitherto recorded.—*Note added when the paper was read.*]

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in width at its mouth. The city lies in a basin; it is all well within, that is below, the 100 foot contour line, or line of level, which passes close to Glasnevin, the Catholic Church at Phibsborough, the railway tunnel near the Zoological Gardens, Richmond Barracks, Harold's Cross, &c., running a long distance up the valley of the Liffey. The basin in which Dublin lies is pretty widely displayed; so that the town, as seen from the neighbouring hills on the south, does not appear to be in a confined hollow, though for the most part low lying. The tide runs up the Liffey to Chapelizod, so that it passes right through the town to its inland side; consequently the level of the middle parts of the town is but little above high tide. About seven miles south of Dublin we come to the northward end of the range of the Dublin, Wicklow, and Wexford mountains, which range extends to the S.S.W. as far as New Ross, or about seventy miles. On the north side of the mouth of Dublin Bay the Peninsula of Howth rises to the height of 563 feet, and on the south side of the mouth the Killiney Hills rise to 512 feet.

As to the geological structure of the neighbourhood of Dublin,—the city and its environs stand upon an outlet of the extensive limestone plain, which occupies most of the central parts of Ireland, and which reaches the coast only in a few places, as near Dublin. Regarding the so-called Old Red Sandstone of this district, of which there are some small exposures in different places, as the base of the Carboniferous formation; that formation was laid down on a floor of Lower Silurian, granite, and Cambrian rocks. These rocks emerge from beneath the Limestone on the south of Dublin, and there form the mountainous ground already mentioned. On the north of Dublin Bay the Cambrian rocks rise to form the Hill of Howth; while the Lower Silurian emerges at Lambay Island and at Portrane, on the opposite coast, and about Balbriggan, at the northern end of the County Dublin. The Carboniferous Limestone thus lies in a trough or depression in the older rocks, in which it was deposited unconformably, as its upper parts overlap the lower, both on the north and on the south, and there lie directly on the older rocks. This formation, then, around and above the head of Dublin Bay does not form a stratigraphical trough; though in the northward neighbourhood of Dublin it might be said to constitute one side of such. Dublin and its environs stand on the middle and upper divisions of the Carboniferous Limestone, which about here are not distinguishable, and are composed principally of Calp, or a dark earthy limestone with dark grey shales, though occasionally containing beds of good pale limestone fit for burning; its thickness in this district is un-

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known. The Lower Limestone, composed generally of a much purer and often very pure limestone, crops out to the northward of Dublin.

The superficial quaternary formations consist, first and principally, of stiff boulder-clay containing well blunted and scratched blocks and stones. As shown by its materials and the circumstances of its occurrence, it has been carried hither from the westward, or, as the groovings and scorings on the rocks produced by the passage of its stones indicate more accurately, from the W.N.W. Thus, Lower Silurian and granite subsoil on the south of Dublin is covered by limestone drift, and has a limestone soil and water strongly impregnated with lime. In the higher parts of Dublin it is this formation which forms the surface. The boulder-clay is in many parts of the district covered with water-washed sands and gravels, and with mounds and ridges of such material, called eskers. A portion of the western side of Dublin stands on this deposit. The low ground of the eastern and of the central parts of the city along the Liffey consists of raised beach; this extends from beyond the mouth of the Tolka River on the north, to Donnybrook and Merrion on the south, penetrating up the course of the Liffey and merging into its alluvium. Some of the low ground about the mouth of the Liffey has been artificially formed from the dredgings of the river.

In considering the sanitary relations of the geological conditions, thus briefly described, we shall pass by the older and deeper formations, with which we are but little concerned at present, and begin with that pre-quaternary formation on which the city directly rests. This, as we have seen, is Calp, or earthy limestones and shales of some considerable depth, which is underlaid by pure Lower Limestone, which comes to the surface northward of Dublin. The Calp, regarded lithologically—that is, with respect to its material—is not a good water-bearing formation, on account of its impermeability. This is illustrated by the fact, that wells have been sunk in Dublin to very considerable depths, and at great expense, without meeting with water. If the borings had reached the water-bearing strata of the Lower or pure limestone, beneath the Calp, doubtless water would have been obtained, since, as we have said, this reaches the surface northward of Dublin.

But though the undisturbed Calp is generally an impermeable and bad water-storing and water-yielding formation, yet its occasional interstratified beds of pure limestone and sufficient breaks and faults may, in places, allow the ground-water to pass freely enough; and, consequently, there are numerous springs and wells within the area of Dublin, both north and south of

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the Liffey, though far from enough to afford a water supply sufficient for the citizens generally.

As the population increased it became necessary to obtain water from other sources, and recourse was had to the Royal Canal, the Grand Canal and the river Dodder. But besides the want of sufficient head of water to afford the requisite hydraulic pressure to force the water to the higher parts of the town, all these sources of water, as well as many of the wells, were seriously contaminated by organic and other impurities.

In consequence of this the project was set on foot of obtaining water from the Vartry valley, Co. Wicklow, with what success we all know. The copiousness of the supply obtained has far exceeded the expectations even of the promoters of the scheme. Thus the upper part of the catchment basin of the Vartry river has artificially become part of the Dublin basin, in the geology of which we are now interested from the sanitary point of view. It lies away from, and above, the limestone drift, which so greatly affects water even on other than limestone areas, and is all situated on the Cambrian and Lower Silurian rock formations, both of which afford pure spring water, which of course is affected somewhat by the humus or vegetable soil, of comparatively little account in that district. The result is a very pure soft water, pleasant to drink and admirably adapted for all household purposes, and thus conducive to health, comfort, and economy in various ways. It is principally to the great activity and zeal of the late Sir John Gray, Chairman of the Water-works Committee of the Corporation, that the citizens of Dublin are indebted for this great benefit.

The Vartry water is, of course, capable of becoming very impure if the house-tanks from which it is drawn be not properly attended to; this, of course, is not to be laid to the account of the water itself. We may here mention, though it is beside our present subject, and a comparatively unimportant matter, that the water from the other sources was so charged with lime salts that it gave rise to troublesome incrustations of lime in boilers, &c. The Vartry water has a great advantage in this respect, but there must be placed on the other side of the account that its very purity enables it to attack and oxidate the insides of iron pipes, boilers, &c., to an inconvenient extent.

With respect to the condition of the soil about Dublin—over the greater part of the neighbourhood, and in the higher parts of the city, it rests directly on the stiff, impervious boulder clay; and in the low parts on the east, and along the Liffey, on the raised beach already mentioned, which consists of porous sands and gravels. The imperviousness of the boulder-clay, which prevents the surface-water from descending is, of course, calcu-

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lated to maintain dampness in the soil lying upon it. This tends to produce the evils well known to be due to such a circumstance. Of course, the sanitary condition of a district is the complex product of a great variety of factors, and when considering these separately we can speak only of the tendency of each. A soil kept moist by an impenetrable subsoil is colder than it otherwise would be, and produces humidity of the air, thereby tending to cause rheumatism, colds, and affections of the respiratory organs. In some cases the moisture of the soil must promote noxious exhalations, which have their own results in fevers, &c.

Passing over a limited area in the west of Dublin, which seems to be covered by esker material, we shall now consider the low gravels, &c., of the raised beach in the eastern part of the city, which penetrates into the central parts, and, higher up, merges into the alluvium along the sides of the Liffey. Dr. Mapother, in his *Lectures on Public Health*, 2d. ed., 1867, shows close correspondence between prevalence of cholera and lines of water courses in the area of Dublin; though, as he points out, this may be partly due to some of the streams having been converted into sewers, which may not sufficiently carry off the land drainage, or which, from defective construction, may allow their contents to pass into the surrounding soil.

Dr. Grimshaw has made some elaborate investigations, in continuation of Dr. Mapother's observations, to test the truth of some of Pettenkofer's views respecting the insalubrity of porous ground *in a city*, or thickly-populated district. He gives detailed results of his researches in a paper in the *Dublin Journal of Medical Science*, April, 1878. He shows that, in corroboration of Pettenkofer's conclusions, there was a great proportional preponderance of cholera cases, both on the pervious formation of the raised beach and close to old stream courses. He observes that a careful consideration of the conditions produced by one of the old stream courses shows that they are very similar to those produced by the presence of a pervious stratum, such as the gravel beds of Dublin. The old stream course, contaminated by sewage, with houses built in it and alongside it, with porous foundations, and possibly standing on the débris of old houses, may have much the same effect, relatively to the present matter, as a gravel bed. The porous ground, of whatever kind, absorbs and retains sewage matter; whilst on impervious ground, like that composed of boulder clay, this is better enabled to flow away and to be carried off by surface water. As Pettenkofer shows, porous, contaminated ground is most dangerous, *cæteris paribus*, when the surface of the ground water is rising and driving upwards the gases

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contained in the interstices of its materials. Pettenkofer considers that the discovery, by Koch, of the cholera bacillus does not necessitate any modification of his views on the matter in question.

Within the area of Dublin the porous ground is damp, from being in a low situation to which the surface-water gravitates; while the soil on the impervious boulder clay is damp for the reason mentioned above. The character and conditions of the Calp limestone tend to increase the dampness of the soil generally; because while lithologically impervious, it must be, as we have seen, traversed by many breaks or faults which let up the ground-water from beneath which has come from higher parts of the surrounding neighbourhood; while such divisions would not be calculated to drain a stiff clay as well as general permeability to water would do. This suggests the mention of a disadvantage connected with the Vartry water-supply which results from its very excellence, convenience, and copiousness. The great employment and great, perhaps unpreventible, waste of it add to the surface water, which is not sufficiently carried off from the lower ground by drainage. In addition to which, the great disuse of the wells must cause a rise of the surface of the ground-water, both beneath the boulder clay and in the low-lying gravels. This is illustrated by the fact that within the precincts of Trinity College the level of the ground-water had risen to such an extent that it was found necessary to keep it down by pumping, at the expense of about £1 per day. This demonstrates the necessity of some such scheme as that proposed, of making intercepting drains or sewers along each side of the Liffey, whence the water and sewage should be pumped.

With respect to the general form of the ground in the vicinity of Dublin, which is connected with and dependent upon its geology, there cannot be much doubt but that the Dublin mountains must have some beneficial effect in occasionally supplying the city with mountain air; and this, apparently, without increasing the annual rainfall, which, as a general rule, is less here than anywhere else in Ireland, according to Mr. Symons' tables. To this may be added that the prevailing direction of the wind in Dublin, which is W., and not S.W., the prevailing direction for the country at large, seems to be principally due to the lower strata of the south-westerly winds turning at Dublin into the wake of the Dublin and Wicklow range.*

* Vessels leaving Dublin or Kingstown with a westerly wind intending to go down Channel very frequently find the wind against them,—that is, with much southing,—when they have got off Bray Head; this difference being clearly the effect of the mountains.

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With the exception of the easterly wind, the westerly wind along the valley of the Liffey is that best calculated to *scour* the basin of Dublin of mists and exhalations, and this is the prevailing wind, thanks, in great part, to the mountains.

As shown by statistics, the prevailing westerly draught of good air along the Liffey more than makes up to the dwellers on the quays for the deleterious effect of the effluvia from the bed of the river at low tide. It appears that this effect is felt much more strongly in the streets which run north and south from the river than upon the quays.

Easterly winds will clear the basin of Dublin still better, but they are obviously undesirable in other ways. It has been pointed out that the *aspect* of the bay and the hills on each side of its mouth must act disadvantageously by causing an increased draught of such winds over Dublin.

The general tendency then of the geological conditions of the neighbourhood of Dublin to produce dampness and coldness of soil and of atmosphere must be modified, to an appreciable extent, by the circumstances now mentioned.

The grand lesson that is taught by the consideration of the geological conditions of the neighbourhood of Dublin is the necessity of improved drainage of the subsoil on which the city stands.

This discussion applies to the four preceding Papers by Dr. C. A. Cameron, Prof. Hull, Mr. G. J. Symons, and the Rev. M. H. Close.

Dr. Tichborne (Dublin) could bear testimony to the rise in the level of the water in wells in many places since Dublin was supplied from Vartry. In one particular case, although the level of the water was higher its quality was not changed, as evidenced on comparing an analysis lately done, with an old analytical report made previous to the introduction of the Vartry supply.

Dr. Edgar Flinn (Kingstown) suggested that where wells from 12 to 18ft. deep were used they should be covered in and cemented all round six feet from the surface; and that only one bucket or utensil should be allowed to be used for drawing the water from each well: thus a fruitful source of contamination would be prevented. A great proportion of the epidemics of infectious diseases that occasionally decimated large districts were distinctly traceable to the contamination of drinking water with sewage or other animal matter. Hence it was evident that where the people drew their

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water supply from wells great care should be taken to prevent the least possible amount of pollution.

Surgeon-General DE RENZY (Bray) could not concur in Pettenkofer's views with regard to geological formation and cholera; the result of his own observations, extending from the Punjaub, one of the driest countries in the world, to Assam, one of the wettest, being that the disease had no dependence whatever on geological formation. He had known cholera to prevail at every elevation, from the level of the sea to heights of upwards of 7000ft. in the Himalayas, on every description of soil, in places where the subsoil water was within three or four feet of the surface, as also in places where the soil was utterly destitute of moisture to a depth of 100ft, or more. At Peshawar, a place notorious for its cholera epidemics, the soil is absolutely dry to a depth of over a hundred feet. The trees would all die from want of moisture if they were not supplied with water by artificial irrigation, so dry is the subsoil. Sirsa is another place of the same kind. The soil is absolutely dry to a depth of 120ft.

Dr. W. J. SIMPSON (Aberdeen) considered that in view of the statements of Dr. Cameron the local authorities should certainly take up the subject of the water supply. He did not think Ireland was exceptional in this respect, for knowing many parts of England and Scotland very well he could say that in the rural districts especially, and in many of the towns, the water supply was difficient in purity.

Prof. HULL (Dublin) remarked that the more one heard these discussions the more one became impressed with the enormous value this Association must be to any district in enforcing a knowledge of sanitary measures, particularly in regard to water supply and drainage. Everyone who had had much experience must know the profound ignorance that prevailed in many rural districts on this subject. As to Dublin it was a reproach upon it that, with this Congress sitting there, they had no complete system of main drainage in operation, and he hoped that if ever the Congress returned this reproach would have been wiped away. As to the question of the rise of underground waters it was desirable they should have further information supplied to them from year to year, and this could only be obtained through the officers of the Corporation. He begged to move that after the statements which have been made with reference to the rising of the ground waters under the terrace bordering the sea and the Liffey, the Council of the Sanitary Institute be recommended to request the Corporation of Dublin to consider the desirability of making arrangements for determining the rise and fall of such waters.

The motion was seconded by the Rev. M. H. CLOSE, and carried unanimously.

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On "Air and Ventilation," by JOHN COLLINS, F.C.S., F.G.S.

"The strength of a people does not depend on the absolute number of its population, but on the relative number of those who are of the age and have the strength for labour."

Under the ordinary conditions of our lives there are ordinary causes of disease always present among us, around us, and often within us, which, seeking a weak point in our armour, can be withstood only so long as we maintain a resistance more powerful than the attack.

It is the young, the aged, the intemperate, or those exhausted by toil or mental effort, who give way.

Disease begins where resistance ends, and resistance is always impotent where vital force is weakened or destroyed.

Sanitation aims to increase that power of resistance.

It affects the comparatively strong, making him stronger, while it lessens the weakness of the already weak. It assists in the provision of better dwellings, of more efficient drainage, of provision for copious supplies of fresh air, and of pure water. It leaves a mark on a community which is as legible as a brand on the forehead of its people. Their nobler forms, brighter and more cheerful faces, their clear complexions and more elastic gait are unfailing tokens of improved sanitation.

At home or abroad, the condition and arrangement of houses and streets, and the physique and beauty of the people, indicate most surely the attention which is paid to the laws of health; and the "death-rate" and the sick-roll will vary as the attention which has been paid to sanitary requirements.

Our objects should not be very far in advance of the convictions of those with whom we have to deal. "Can a man not do what he likes with his own?" "An Englishman's house is his castle!" These are "saws" so familiar that we have come almost to admit them as truisms. And it is hence the more difficult to impress this fact, that the most precious possession of a man—viz., his life—is not his own to do with it whatever may seem best in his eyes. It is the property of the state, for every man who is a member of a community is a unit making up its strength, or its weakness, and he belongs to it.

Our existing sanitary laws arm us with powers to close polluted wells and pumps, prohibit the tenancy of dwellings unfit for human habitation, and prevent undue crowding therein,

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to inspect common lodging houses, and prohibit the doing or the leaving undone any act which, resulting in a nuisance, tends to injure public health.

But the great secret of any real improvement in our sanitary condition is the provision for the supply and circulation of purer air in our dwellings and workshops. A plentiful supply of good wholesome water is one of the Creator's best gifts, and is an absolute necessary of life. It cannot be altogether neglected without entailing misery, disease, and death. By drinking foul water we may, and we undoubtedly do, often incite disease; but this is insignificant when compared with the results arising from the steady imbibition of impure air. For we do not drink air as we do water—intermittently—and to a comparatively small extent. We imbibe it equally during our sleeping as in our wakeful hours, and the *smallest* interference with the regularity of this supply is fatal.

The atmosphere is, speaking generally, one mass of impurities.

Every person, on an average, pours into the air about ½lb. of used up carbon per day. This comes from the lungs mainly into the air as carbon dioxide, which is not capable of supporting animal life. Hence, in a town population of 100,000, we have a daily addition to the already impure air of 81 tons, 16 cwts., 3 qrs., 17 lbs. of an irrespirable gas from this source. Then we have "smoke," together with the many and varied products of combustion and of chemical industry.

Much of the evil which would result is, fortunately for us, avoided by the working of the beneficent natural law of "gaseous diffusion" which is alway at work.

It should never be forgotten that it is stagnant air which is dangerous. It is more what we abstract than what we add which gives to the air its poisonous characteristics, and this is in a lesser degree what happens to everyone who is poisoned when deprived of the constant changes of respired air by adequate ventilation. We create a poison to our system when the atmosphere we breathe is not surely and constantly renewed. We slowly and surely undermine the vital force and power within us, and, when infection approaches, we are found unable to resist the attack.

Our town population of 100,000 would probably occupy not less than 20,000 houses, each of which will burn at least 1 cwt. of coal per week. Hence we get a domestic consumption of 1,000 tons weekly. Taking the mean average sulphur in this coal as 1·25 per cent. as oxydized, we shall get 12·5 tons of sulphur equal to 37·5 tons of sulphuric acid. And the money value of this noxious and hurtful gas with which we pollute the air, and which is lost to us, taken at £5 per ton, is £67 10s., or

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£3,250 per annum. What must be the magnitude of the evil; what the loss, when it is remembered that we raise over 115 millions tons of coals yearly. This is an addition to the atmosphere, and outside our dwellings.

But what do we find inside?

In every room where we find artificial lighting we have a concurrent production of foul air, for the removal of which efficient ventilation is required. If we take a room in which four ordinary gas jets are burning, each consuming its five cubic feet per hour, we have a total consumption of 20 cubic feet per hour, and of 100 cubic feet in the five hours of a winter's evening. Taking a low percentage of sulphur compounds other than sulphuretted hydrogen, as present, viz., 14 grains sulphur for 100 cubic feet, we have 42 grains of sulphuric acid; and we have probably 12 grains ammonia, yielding 44 grains of nitric acid, in addition to 11 grains of water. Besides these, we have the products of combustion of the gas itself, viz., the carbonic dioxide and water.

It is said that eight million tons of coal are annually distilled for gas making. Allowing one ton for each 10,000 cubic feet of gas produced, we shall find we have some 80,000,000,000 cubic feet of gas produced and used per annum. And if we assume that all this gas when supplied to the consumer contains the afore-mentioned quantities of sulphur and ammonia, we may see how almost incredible is the waste and damage. To take a case of a town known to the writer, where the make is over 400,000,000 cubic feet per annum, we shall have this waste and damage represented by some 4·5 tons sulphur, equal to 13·5 tons sulphuric acid, together with about four tons of ammonia. This four tons of ammonia represents about 16 tons of gray sulphate, containing 24 per cent. ammonia, and worth about £290. So that while we are content to bear the presence in such quantity of noxious and non-illuminant gases, causing damage and loss in every way, we are also, and absolutely, throwing away the £290 per annum before mentioned.

Coal smoke is a luxury, inasmuch as we are content to pay very handsomely for it. It is not a very substantial thing, and yet see how it leaves its mark on our public buildings—on our walls, inside and out our dwellings, and in our lungs. Some 500 years ago our Parliament busied itself with this "burning" question. It complained of the smoke and noxious vapours arising from the use of "sea kole," and proclamations were vainly made against its use.

The hideous blackness which robes us in mourning, and which gives an unartistic Rembrandt-like tint to the surfaces of our public buildings—which defiles our dwellings and all

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our surroundings—must be removed, if not on æsthetic considerations, on appeal to the pocket. We are all more or less affected by the question, and its gravity to the teeming thousands of our large manufacturing centres cannot be over estimated.

The atmosphere of the dwelling necessarily partakes of the character of that outside, and by that amount adds to the air pollution of small, ill-ventilated, over-crowded, and unsanitary dwellings.

A room 10 feet square has a capacity of 1,000 cubic feet, and this is no more than is necessary for one adult person, and doubly necessary in the case of a bed-room.

Respiration and occupation have a certain and easily estimated vitiating effect on the atmosphere, and, for sanitary uses, it should be entirely changed by ventilation twice or thrice every hour. That is to say 2,000 or even 3,000 cubic feet of air, pure and fresh, should be thrown into the room for each person occupying it during each hour. This is no fanciful, extravagant, or excessive estimate, but it is founded on the results of close observation, and of careful analysis. One test of the quality of the air after respiration is furnished by the quantity of carbonic acid gas it is found to contain, as this compound is not only injurious in itself, but also affords a very practical means of estimating other impurities such as organic matters. Pure air contains, in every 1,000 parts, oxygen, 209·6; nitrogen, 790·0; carbonic acid, 0·4, with minute traces of ammonia and organic matter, and a little (variable) quantity of moisture.

Air, to be regarded as pure, should not contain more than 0·4 parts carbonic acid per 1,000 of air, and it has been very frequently observed that when this quantity increases to 0·6 per 1,000 our sense of smell indicates that the air of the room is perceptibly tainted. It is obvious that these conditions are by no means fulfilled in the case of the majority of mankind. In the dwellings of the labouring poor they are scarcely ever so, and in the houses of the rich rarely so. No doubt we do sometimes find them fulfilled in bed-rooms, but hardly ever in sitting and in "living" rooms.

It would be interesting to enquire fully into the various modes in which the air is polluted and deteriorated, but the limits of this paper will not admit of this; and it may suffice to say it is by combustion and respiration—by sewage emanations and from excrementitious matters, and by noxious vapours from various trade processes.

But we may roundly assert that air, even after respiration, is changed in the following characters:—Its carbonic acid is increased from 0·4 to 0·5 per cent., while its oxygen is reduced

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by about 8 per cent. Besides, some effete organic matter is thrown off by the lungs, and a fine epithelial dust from the body. Wherever we have this organic matter, and especially when it is combined with water, we must assuredly have putrefactive decomposition, which, in its turn, gives rise to various volatile compounds which induce a lessened power of resistance to the effects of disease. Who has not remarked the sickening, fœtid, unwholesome smells from low types of the "great unwashed," and from his even still more neglected dwelling: and who that has realised this smell has not been affected thereby?

I append tabulated results of analyses of air under varied circumstances, which, read with and by the light of this paper, may be found instructive and of some value.

They are in part my own work, and for the remainder I am indebted to my assistant, Mr. Walter Hepworth-Collins, who has given long and interested attention to the subject.

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TABULATED RESULTS.—AIR ANALYSES.

Samples taken.	Grains per cubic feet. Ammonia. Free.	Grains per cubic feet. Ammonia. Albumenised.	Hydrochloric Acid.	Sulphuric Acid.	% vol. Carbon Dioxide.	Remarks.
1. In Garden at Farnworth	36·1	85·5	102·2	99·6	0·046	Average 800 obs.
2. In Little Lever	25·9	49·4	116·5	102·4	....	750 „
3. In centre of Farnworth	38·6	92·0	87·9	123·3	....	800 „
4. Near large works, Bolton	16·7	4·3	36·4	194·3	....	800 „
5. In narrow back Street, Bolton ..	29·9	53·6	36·9	169·2	....	800 „
6. New Public Park, Bolton	5·8	26·8	25·2	45·2	....	750 „
7. National School, "Howarth's" ventilated	....	....	....	....	0·0461	.....
8. Quarter Sessions' Town Hall, Bolton ..	....	....	....	....	0·0464	.....
9. Bed-room, 18in. from floor	....	....	....	....	0·0614	.....
10. „ 18in. from ceiling	....	....	....	....	0·0501	.....
11. „ 18in. from floor	....	....	....	....	0·0465	.....
12. „ 18in. from ceiling	....	....	....	....	0·0624	.....
13. Public Hall, Southport, unventilated ..	....	....	....	....	0·0602	.....
14. „ „ { "Howarth's" ventilated }	....	....	....	....	0·0462	.....

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"EDUCATION BY PROVERB IN SANITARY WORK,"

LECTURE TO THE CONGRESS,

BY

ALFRED CARPENTER, M.D., M.R.C.P. (LON.), C.S.S. (CAMB.).

THERE are two points in the study of the causes which shorten human life, which must strike all thinkers upon the subjects of health, of disease, and of death. These points may well form the commencement of my address to the earnest sanitarians who are now assembled in this city of Dublin.

The first of these points is the sacred feeling which attaches to human life, to the spiritual essence by which we live and move, and have active existence, and which feeling is instinctive in the breasts of all who may be assumed to have had the privilege of a spiritual contact with the Supreme Being; this spiritual essence being a something altogether different to that life which belongs to animated nature, exclusive of that attached to humanity.

The second is the carelessness with regard to this same life, the indifference with which its extinction is regarded by barbarians and uncivilised communities, and also by a portion of the civilised world, who ignore the existence of a Supreme and Benevolent Architect of the Universe. The more uncivilised the race, the less is the respect which is paid to the maintenance of human life. There are still nations upon the face of the globe, who, when their parents or relations become old or labour under any distemper which cannot be cured; cut short their days with a violent hand, in order to be relieved from the burden of supporting and tending them: and there are yet some countries in which the children are destroyed when

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not wanted, much as we destroy whelps and kittens in our own land. I have even in my own day, in our own native country, heard it represented that it would be an advantage to the State, to the locality in which they live, and even to the poor creatures themselves, if some of the inhabitants of our lunatic asylums, our prisons, and our workhouses, could be put to death in some painless way, by which their sufferings could be shortened here, and the expense which their maintenance entailed upon the community altogether avoided. There are also men who boast themselves as being among the highest of intellectual beings who would deal in a similar manner with the habitual drunkard, by placing within his reach as much as he wished to take of the poison which destroyed his health, with the object of hastening his departure from among us, and so saving the State or his personal friends any further trouble and expense on his account. These individuals are but evidence of the brotherhood which exists between some of the tribes inhabiting the Chinese Empire, or of the interior of America with these same intellectual beings among Queen Victoria's subjects, who like the barbarians referred to, ignore the sacred character of the vital spark, and have no idea of a future state. In this part of the world they call themselves philosophers, and style the subject a study of the Euthanasia.* But the sacred character which attaches to human life is not likely to be extinguished among us, and whilst the instinctive feeling which belongs to humanity, arising from spiritual contact with a higher power, has sway, we are not likely to degenerate to a class of low utilitarians or become the supporters of a principle of a cynical selfishness. A nation or a class encouraging a feeling which diminishes the sacred character attached to human life is a degenerate nation or an uncivilised race. This cannot be said of either the Celt or Saxon as a race, though some among us give utterance to doubtful principles. If there is one thing more than another which is uppermost in men's minds in this our day, and in our own land, it is as to how disease may be impeded, how our children may be preserved to us, and how we may attain to a length of days which statistics have told us should be ours, but is not. It is only within this present century that Society has been made aware of the loss which accrues to the community from the premature deaths of immense numbers of its atoms: personal interest is brought forward in support of humanity, and the welfare of the state is shewn to be also in accord with the sacred feeling which protects the life of its citizens. Although the people generally had not been aware

* Meaning an easy departure and utter annihilation.

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of this loss until very recently, it was well known to wise men in all ages, and imputed by them from various motives, either to the anger of the Supreme Being, or of those who in the more degenerate ages of the world represented Him in the public mind. The tenth plague in Egypt, in which the death of a child in every family was the natural result of a disobedience to sanitary law, ultimately led to the promulgation of the first set of sanitary edicts with which we are intimately acquainted, and which were made binding upon the Israelitish people by being engrafted upon their religious performances. It is thus that the wise men of old were enabled to "save some" by means of Proverb or religious dogma, and the sanitary observances inculcated by Moses in the wilderness of Sinai were based upon his acquaintance with the evils of town life, and the disadvantages to the State which a residence in the closely confined cities of Egypt had brought upon the Hebrews. The forty years' wanderings in the air of the desert purified them from the diseases which had debilitated their frames, and which the flesh-pots of the valley of the Nile had assisted to cause. The rules laid down by Moses, whilst they prohibited a continuance of the people in a nomadic life, also prevented those evils from arising which were sure otherwise to follow upon over-crowding and its natural consequences in the confined cities of Palestine. Moses was well acquainted with the selfishness and with the egotistical and mercenary spirit especially belonging to one side of humanity. He took measures, therefore, to inculcate sanitary truths by making them into edicts of the State, unalterable by the whims of the people, and this led them to be observed as long as the Mosaic law was the law of the land. Moses and other wise men of old studied human nature; they recognised the difficulties which were in the way of establishing healthy action, and pointed out to their disciples that health followed upon obedience to certain laws. They knew that self-indulgence, sloth, and the love of money, were stronger moving powers in the minds of the masses than benevolence, than industry, and virtuous abnegation of self. The spirit which led Moses to lay down the laws in the Mosaic precepts, which are the basis of all sanitary codification, led to the popular association of Proverb in sanitary work.

The same moving spirit caused the priests and priestesses of the temples of the gods of the heathens to give utterance to sound sanitary directions, veiled in dark sentences, and accompanied with rites and ceremonies tending to exercise the imagination, and to lead their devotees to carry out their behests in blind obedience, and without thought as to the reasons for their orders, or any reference to the God of Nature in the work to be done. But being myself an earnest believer

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in natural law, I understand Nature as being in the words of one of our poets, not only in the material and visible world—

> "In the round ocean, and the living air,
> And the blue sky (*but also*) in the minds of man,"

and that all actions which take place in the world, all changes of matter, and all the results of such, are caused by laws implanted by the Divine Architect of the Universe, in imponderable as well as in material agencies. I believe that the former, though invisible and unweighable, are infinitely more powerful than the latter. That the material world and its inanimate matter is acted upon by the immaterial and the spiritual world, through animated nature, in various ways, which may be beyond our conception, but which nevertheless are according to general laws, and that it is always in accordance with a law when disease of any kind appears, and life is taken away.

It is the object of the sanitarian to find out the forces, as well as the material agencies, which bring these laws into play, especially as regards those forces which influence the health of the people, by means of which life is prolonged or shortened, and the atoms which go to make up a population increase in number or diminish and vanish away. We ask, and we are sometimes able to find out in answer to our question, why those enormous animals which formerly inhabited the earth; why the megatherium, dinotherium, the mastodon, and the Irish elk have departed from amongst us; and coming nearer to present times, we ask why the Astecks are gone, and the Red Indians are likewise becoming extinct, following in the wake of the elk and the moa, whilst the Celt and the Saxon are spreading all over the world, and showing their superior mental and actively constituted bodily powers in every portion of the earth, and spreading abroad a knowledge of the sacredness which attaches to human life. A belief in natural law, as far as the people generally is concerned, is a belief of modern growth, it is one of the pillars of sanitary work, the other has sprung out of the Christian tenet that we should love our neighbour as ourselves. The term supernatural is still considered as a reality by many, but it is obsolete and altogether out of date to the sanitarian in all things connected with health. If anything arises which is new, or rather which is observed now for the first time, or which is incomprehensible to him, the sanitarian believes it to be the result of some law, the nature of which is at present hidden from his intellectual understanding. If it has reference to the health and well-being of the people, he sets himself to

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solve the mystery, and to find out the bearings of that law which has brought about the apparently incomprehensible result; and whilst acknowledging that all things which happen are the sequences of Nature's laws, the sanitarian declines to regard anything as supernatural or beyond the power of man, to influence, sooner or later, for either good or evil, if means are taken to effect the object he has in view.

For instance, an advanced sanitarian declines to look upon disease, or even upon death, as supernatural, and some of us dare to assert that death, when caused by disease, is not a necessary sequence in man's history. I, as a sanitarian, dare to assert that death, as it ordinarily occurs, is a preventable event, and that disease need not be the cause of death; and in effect I support the views held by those who uphold a belief in revealed religion, that disease is the sequence of man's degradation and fall, and that a restoration to right paths will be followed by the removal of its effects, and with its removal the sacred character which attaches to human life will be made still more manifest.

The sanitarian's study is man's mental as well as physical state; he is able to make out the effects which are produced upon his material body by immaterial as well as material agencies. Both have influenced his actions and his affairs from his first appearance on the earth. He finds that the acts of man are governed by natural laws; that they are often the sequences of acts which were performed by generations who existed in ages long past, and which acts are not ordinarily thought of as having been the causes of those results, and no country in the world gives such proof of the truth of this adage as this Ireland of yours, in which population is decreasing and public health at a comparatively low ebb, whilst the sacred character which belongs to human life is not set at so high a rate by some of its inhabitants as it is on the other side of the Channel.

The sanitarian judges by analogy, and knows that the men of the present day will influence their successors hereafter in a similar manner, if corresponding acts are performed by ourselves. He can prove this fact by irresistible evidence, based, it is true, upon analogy, but the sequence of events, like the rising of the sun to-morrow morning, is all but certain. He appeals to you to assist him in taking such measures as shall prevent similar results in the future, when they may possibly produce corresponding evils to man. There is no proverb so well established as that of "Prevention is better than cure," or, as the old Roman expressed it, "Principiis obsta;" and to it I appeal as one of the bases of my remarks.

The sanitarian shows you that whilst a few years ago the average age at death of all persons who died in a given period of

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time in some of our towns was not more than twenty-five years, and that some districts in Dublin at this moment show a similar rate in the length of life of those living in those districts, whilst in others it is thirty-five or forty; and that which is called, in irony, Civilisation or Culture, is partly responsible for the gradual decrease in the length of days of man's life upon earth; for the shortest average lives were in the most crowded, but also the most highly civilised cities. We are able to show you now that the average age of man at death has risen within the last few years to over forty-one (the whole kingdom being considered), whilst in some given districts it rises to sixty; and we assert that this increase in the length of life is due to sanitary work: to a better knowledge of the causes of disease among the people, and the removal of those incidences which belong to a neglected poverty.

We ask, Why should conditions exist in some of the bye-streets of Dublin, of London, and of Liverpool, or Glasgow, by means of which the average age of those who die there is considerably less than thirty, whilst the instances in which life has been prolonged to 100 are numerous even in Ireland itself? The sanitarian asks, If Biddy Sullivan could live till after her ninety-ninth birthday, why should not the same result happen to every other person born in Ireland? Every sound seed produced by a given plant can be cultivated and made to produce another of the same kind if proper measures are taken to bring about the object in view; it is only a barbarian plan which leads to a so-called survival of the fittest. The sanitarian asserts that Bridget Sullivan did not die, in the ordinary sense of the term, from disease. There was no apparent disease in her frame; there was evidence of age, which showed itself in the white hairs, the dim sight, the hardness of hearing, and the want of taste, which came on in the last few months of her life, like changes of colour which take place as a cornfield approaches the time of harvest; but those conditions arose from failure to carry out certain attributes which belonged to the material body. They were not attended by pain, and when life ceased to be, Biddy Sullivan shuffled off the mortal coil, and joined the majority without suffering a pang of any kind. I have in my time watched many and many a death-bed, and in the fact of death itself, as separated from the disease which has brought on the premature ending to mortal life, I am satisfied that pain is not and need not be a part of the process. There is no more pain in dying than in being born into the world; uneasiness connected with spinal actions there may be, but pain is no part of the process. "I am in no pain," has been the answer to my question hours before the end has come: the

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departure has taken place, the separation of soul from body has been effected without a pang of any kind. Pain is a consequence of disease. The end of mortal life on earth will come, but disease need not be its precursor, and death therefore need not be regarded as painful if disease is prevented. Bodily pain is the evidence of some abnormal action which is interfering with the ordinary course of nature; it is a danger-signal exhibited by the nervous system to show to the owner that some law has been transgressed, and some change effected in the nerve battery which regulates organic life, which has led to changes not consistent with health and freedom from suffering. Pain is the manifestation of a warning on the part of organic life which should cause the sufferer to alter some course of proceeding tending to set up mischief, or it is the necessary sequence of things in a return to a right and healthy path.

It is the object of the sanitarian to bring about conditions which diminish the frequency of early death, which assist to remove bodily pain from the list of human gievances, and to pave the way for that time when every person born into the world will enjoy his birthright without having it curtailed by the acts of other people. Every child born into the world has a right to live to the natural end of his mortal life, and, whatever is taken away from that 100 years which is his birthright, is so much fraud upon him; and is so much enjoyment upon earth of which he has been robbed. The development which should be the result of that enjoyment has been prevented, and his hopes of a future and a brighter world possibly taken away, or if his sojourn is attended with suffering here, the pain endured is so much of the fire of affliction which helps to purify the spiritual being and prepare it for that brighter world beyond the grave. A just and benevolent Maker will no doubt rectify this in some way beyond our ken, but the fact is there. That length of life which was attainable by Biddy Sullivan, viz., close upon a century, is the birthright of all of us. We do not attain to it because our forefathers did that which was right in their own eyes, without reference to the effect of their actions upon their descendants, as well as upon those around them: or our neighbours, or we ourselves, do acts inconsistent with its continuance. We should not forget that our forefathers were ignorant of the influence their conduct would have upon their descendants.

"Salus Populi suprema lex," is a very old proverb in the cause of sanitation. It was a Roman saying when the Commonwealth was the first thought of the true statesmen of that old Republic, when a few great men cared for their country more than for their own pockets, and preferred

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its welfare to that of their own comfort; but the teachings of the proverb have had until quite recently but little force in the larger part of the United Kingdom, and certainly less in Ireland than across the Channel. That proverb in later times, however, has been more often used for purposes of persecution than for the public benefit, and any good effects which it might have had have been much more than counteracted by others which have shortened life and propagated disease, but which, curiously enough, in the abstract are looked upon from very mistaken ideas, as essentials to the Magna Charta of liberty. "A man's own house is his castle," and "Every man has a right to do what he likes with his own." These unpatriotic proverbs, taken in a practical sense, have injured man's constitution and damaged the frame-work upon which man's body has been built, by being applied to his own purposes by the ignorant, the designing, the selfish, the vicious, the miserly, and the indolent. Instead of being applied as protections against evil, they are opposed to true patriotism and the general welfare of the people, they have been used for the manufacture of evil, and the multiplication of foci from which disease has been spread, and life taken away from its owners; they are therefore quite antagonistic to the sacred feeling which ought to belong to human existence. They have shortened man's life, have weakened his intellect, have diminished his muscular power, and have sometimes caused his descendants to throw themselves under the Juggernaut car of an imaginary destiny, as if there was no escape from its consequences, no help for unhappy mortals from the sufferings of disease or the pains of the consequent death. The disciple of sanitary law has a better knowledge, he knows that man's destiny as to disease is to some extent in his own hands, unless his system has been tampered with by acts of his ancestors or the laches of himself or of his neighbour, or neglect of the State, in which cases he is somewhat hampered by mortgages which will have to be paid off by himself and his descendants. Notwithstanding this the sanitarian sees in the dim distance the realization of his hopes, and with the Prophet Isaiah he believes that the days will come when "There shall be no more an infant of days, nor an old man that has not filled his days, for the child shall die a hundred years old." (Chap. 65, v. 20.) But "that the sinner being a hundred years old shall be accursed." Clearly showing that health would come before universal Godliness. He sees an actual felicity in sanitation, as expressed by my predecessor in the address which he gave to the Congress at Glasgow, and which felicity may be looked upon as super-natural by the unlearned. The sanitarian sees the time when the knowledge of

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the sequence of God's laws shall be spread broadcast throughout the world, so that the consequences of a man's acts shall be as visible to himself and his friends as they are even now to the pathologist and the physician; and seeing the effect of those acts upon the frames of other men, he shall be careful to avoid corresponding effects by not committing the mistakes which may have led to their production in himself, in his descendants, or in his neighbours: for heredity in disease, or a deficiency in muscular and mental power is as certain to accrue to men as it is found to among the lower animals of creation as regards form and other attributes. It may be in the early future, it will be some day, that persons will become ashamed of having to acknowledge themselves to be the subject of diseases, which instead of, as now, exciting sympathy and condolence will be looked upon as blots upon the family scutcheon, and as such to be got rid of or hidden out of sight, and certainly not to be flaunted in the face of a more discerning world than is the present in matters of health. Men will then look out for their life-long companions from among those who are possessed of rude health, who belong to stocks enjoying long life, and from among the intellectually superior, from those with a pure blood and free from hereditary taint, such possessions being of more value than money or position, or even an evanescent beauty, a highly-strung temperament, or an hysterical sensitiveness, which is but too often the evidence of an inheritance from a gourmand, a drunkard, or a vicious man. We ought to look forward with pardonable desire to the time when defects in bodily health will be remedied, not as a man with one leg naturally remedies his defect by taking to a wooden one, but by using measures which shall remove the defect itself, and education of the young will then be on developmental principles. We find, in my own profession, a number of practitioners who fail to see this necessity, when they provide substitutes for a defective faculty in the young and growing youth, instead of rightly cultivating that defective faculty and bringing out its hitherto dormant powers. Spectacles to growing children, straps of all kinds in dress, high-heeled boots, and tightly-fitting corsets, will be sent to limbo, and foolish young people not allowed to go on in wrong lines.

I have used the term destiny with a motive. It is a term which has influenced millions who have surrendered themselves to its sway, and allowed themselves to be unresistingly carried on by the ever moving stream of time. They have been ignorant of the fact, or they have forgotten that the laws which govern matter can be directed by the will of man, and that the order of those laws can be changed by the power of that will. It has

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been forgotten that the will of man is in his own power so long as he holds the reins, but that if he surrenders those reins to others or throws them away because the exertion of that power is a trouble to him, because it is easier to go with the stream "as one sheep follows another," and "one fool makes many," he becomes the slave of a myth, and helps to add to the evil which is in the world, instead of resisting that evil and doing good to his own generation. This is especially the type of the hysterical development of the present day, and which is sadly on the increase, being the inheritance which comes to us from the wine bibbers of former times. If a man has a stone in his hand he can throw it, or not throw it, at some object as he pleases, but, having thrown it, the matter obeys the immutable laws which belong to matter, directed, it may be, by the will of man to some object, but, having left his guiding power, is no longer under his control, and may be deflected from the path which he intended it to take, and ricochet from the straight line, and strike a friend, or even like the boomerang return and injure him who threw it. And as we read in the Talisman—

> "A rusted nail placed near the faithful compass
> Will swing it from the truth, and wreck the argosy."

The sanitarian believes that he can, by using right means—

> "Turn the stream of Destiny,"

and

> "Break the chain of strong necessity,"

(which, as Spencer expresses it)—

> "Fast is tied to Jove's eternal seat."—(*Fairy Queen.*)

The sanitarian does not believe in the permanence of hereditary evils.

It is not my intention to stay long in the distant past, or wander away in the cloudlands of psychological study, but I want you to bear with me whilst I glance at the time when knowledge belonged to the few, when the tendency of the human race in civilised life was to become depreciated in value by ease and luxurious habit, by gluttony and other kinds of self indulgence, scarcely counteracted by the survival of the fittest; when writing was not general, and tradition was the principal mode of transmitting knowledge from one generation to another. Perfect man had become a transgressor, and had let evil iufluences affect his frame. Those men who were more completely developed, and were wiser than their fellows, marked the effect of the unknown and worked upon the fears of the weaker sort, and imputed the sequences of nature's laws to the

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supernatural, as if caused by the anger of the gods. They assumed a power to intercede for the offenders, and even to turn aside "the bolt of Jupiter." Knowledge regarding the true nature of the Supreme Being was limited to few, and those few often used their knowledge for their own benefit. The fears of the people were used for the purpose of turning that knowledge to profit. As a semi-civilization again became established and a theology developed, the oracles of the gods became powerful agencies for the dispersion of dogma both true and false. Sometimes dogma was used for the promulgation of beneficial principles. This was the case when despotic power was in the hands of benevolent men, but, too often, despotism was simply a means whereby the masters of the place held power over the people, and it was only when a truly wise and good man like Solon or Moses was in the seat of power that advantage accrued to the people themselves instead of being used for the benefit of the few. Sometimes it happened that wise men studied the weaknesses of the people, and used those weaknesses for the purpose of inculcating right principles, a custom not uncommon among statesmen in our own days. Faith in the supernatural among the masses enabled them to do this by means of proverb. The promulgation of edicts took the form of religious dogma, and their authors worked upon either the fears or the faith of the people. These attempts to influence them were often made in times when pestilence was at work, and men's minds upset by the dread of an unknown future. Learned and benevolent men wished to bring them back to be influenced by those physical laws, the effects of which were altogether unknown to the masses. Dangerous and rapidly fatal diseases tended to strengthen the power of superstition among them. There was a good side in the means taken, but it had an evil tendency, and it was to that which Buckle refers in his History of Civilization, where he says "The real mischief was that it engendered in the mind, associations which made the imagination predominate over the understanding, which infused into the people a spirit of reverence instead of a spirit of enquiry, and which encouraged a disposition to neglect the investigation of natural causes, and ascribe events to the operation of supernatural ones." (Hist. of Civiliz. Vol. I, fol. 115).

The effect of this mischief is well expressed by the Israelitish proverb referred to by the prophet Ezekiel, "The fathers have eaten sour grapes, and the children's teeth are set on edge" (chap. 18, v. 2). In this proverb we have a distinct reference to hereditary tendencies, and to results which require much hard work to reverse; it applies to ourselves as well as to the antient inhabitants of Palestine, and hereditary tendencies are some of

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the most difficult problems which the sanatarian has to deal with. I want to impress this fact upon the minds of my hearers, and to point out that whilst cholera and fever, smallpox and scarlatina, diphtheria and erysipelas are undoubtedly immediately preventable diseases, yet prevention is not limited to those classes, but that insanity, tuberculous diseases such as consumption and scrofula, cancer, hysteria, and deformity of body and even of mind, as shown by passionate and vicious conduct, are also equally preventable, if we did but know how to proceed in order to stay their incidence. It was about this time that the real father of physic, and, I may say also of preventive medicine, made his appearance in the world, though it is only in recent years that we have realised how much was understood by Moses in this direction. Hippocrates owed his knowledge of physic in a great measure to reading the tablets which were put up in the temples of the gods. These tablets contained accounts of diseases from the effects of which certain individuals had recovered, and also an account of the means whereby the recovery had been promoted. Hippocrates lived about 500 years before the Christian Era, he is said to have died in his 100th year. He was a grand writer. The chapter upon the diet of healthy people may almost be taken as a string of proverbs, and, as such, was committed to memory and observed by his disciples; whilst the aphorisms which he formulated as to the conduct and treatment of diseases are considered to be, in many instances, distinctly true, even at the present day.

The aphorisms have been called a collection of oracles, and no doubt they did much to enable physicians to recognize the nature, and to prognosticate the result in a variety of diseases, and to keep alive some medical information through the dark ages which succeeded the dispersion of the Jews.

He begins by stating that "life is short, that art is long, opportunity fleeting, experience uncertain, and judgment difficult." He says also that a physician must cultivate philosophy if he is to succeed in his work, and he concludes that a physician who is a philosopher is equal to a god.

If we look into the oracular utterances which came from Delphi and other acknowledged fountains of supposed wisdom, we catch glimpses of these truths. Men did things which they were ordered to do by the oracles for the purpose of having themselves or their relations cured of their diseases—things which they would not have done if they had been advised to do them by their local physicians. The order to go and wash seven times in Jordan was, and is, usually too simple an instruction, unless it is accompanied by some mysterious utterances or some cabalistic performances which have an action upon the minds

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of those who are subjected to the effects. Simplicity was not believed and was not understood, and the most ancient proverbs or edicts with which we are acquainted were those which were made into religious observances. Those edicts which relate to sanitary law, and which were promulgated by Moses, are wonderful evidences of his clear insight into the causes of disease; the method by which infectious complaints were to be eradicated cannot be much improved upon by the arrangements recommended even by the intelligence of the present day, for they consisted of ventilation, of washing, of disinfection, and cremation. By making those performances into articles of faith, he was using a power to obtain his object, which was more likely to be effectual than any other then possible plan.

The travels of the Children of Israel in the wilderness furnish several instances of sanitary operations which have not been always put in their true light. We read that the Israelites could not drink the waters of Marah because they were bitter. Those waters were sweetened by the use of the branch of a tree growing in the neighbourhood. This action, which foreshadowed the custom of tea-drinking, is rightly made into a miracle in these later days. It pointed out a way by which water may be purified from its noxious qualities by infusing certain ingredients into it. It is a consolation to the tea-drinker of the present day that he not only takes for his usual diet "the cup which cheers and not inebriates," but he also takes into his internal economy a water which in all probability has been deprived of all noxious ingredients of the organic variety which it might contain when delivered to the housewife. Tea-drinking is a great preservative against cholera and fever. All the classes of disease which is spread by living germs or microbes in potable water, are removed: boiling it and then pouring it upon a material containing tannin is pretty certain to remove all evil from it which can set up infectious disease—for what the boiling does not effect the tannin will, and our tea-drinking friends need not be frightened by the onslaught of any who may happen to be put forward by a certain trading interest, and who at this present day are loudly crying out, "Great is Diana of the Ephesians."

Another custom which had its origin in Arabia and Egypt, and which was instituted by Moses as an edict to be religiously observed, was the burning of incense. They offered to God a part of that which they held to be most precious, and at the same time fumigated the wearing apparel of the worshippers, and to some extent the air itself, and by so doing diminished the chances of the evil likely to arise from the crowded assemblies, which were then held at stated times, for the purposes of religious worship. Plutarch mentions that the

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Egyptians offered incense to the sun; resin in the morning, myrrh at noon, and a compound called kypi at sunset. Moses, probably knowing the beneficial results which followed this ceremony, and having observed that illness resulted when it was not performed, when he resided in Egypt, made it a part of Hebrew worship, and thus secured its performance whenever religious ceremonies were undertaken. Its continuance in the middle ages by the Christian churches was a necessity of the times, and assisted to produce a certain amount of ozonised atmosphere which diminished the chance of the spread of infection among the assembled worshippers. This was done in a pleasant manner; it covered up a noisome smell by one more agreeable. The old proverb hath it "that the smell of garlic takes away the smell of dunghills," so in the end assisted to promote the ventilation of stinking apartments, by which all kinds of mischief were lessened in amount, and the epidemics of the middle ages diminished in frequency and in intensity. A great evil was lessened by a simple plan, which, as a religious ceremony was sure to be performed, but which as a sanitary precaution would have had no chance of observance when infectious disease was not present. Yet the time to prevent disease is before it is grown up in intensity. The destruction of the first germ or seed is of the greatest possible importance, and incensing therefore was, in the middle ages, a necessary precaution for the safety of the priests even more than for that of the people. There is a proverb well known to the gardener, which especially applies to sanitary work of this kind, viz., "One year's seeding, seven years' weeding." This proverb is a true expression of the evils of allowing a single case of infectious disease to grow up among the people. Illustrating great things by a reference to small ones, I would point out to all here the great importance of early intimation being afforded of the presence of infectious disease in the homes of the poor, so that incensing may be performed at the right time, and by the right people. A single case attacked with vigour, by incenses and other agencies, which ought to be immediately available among the people, may be the means of preventing the spread of a serious epidemic, just as a single weed rooted up by the gardener, before seed time, saves him work of the same kind for seven years to come.

Incensing may, or may not, be carried on in our sacred services, but it must be done immediately in all cases of infectious disease by the local authority, and I urge the people of Dublin, therefore, to see that it be carried out. By incensing you will quite understand that I mean disinfecting the air and apparel by a judicious use of proper disinfectants.

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You have an organisation in Dublin which is capable of good work in this direction. The Dublin Sanitary Association, with scarcely 200 members, although it is in a city of 250,000 people, has for the past twelve years been at work in trying to popularise sanitary truths, with a moderate amount of support: let me urge upon you to help it and all similar societies. Shakespeare says truly—

> "The web of our life is of a mingled yarn,
> Good and ill together."
> —(*All's Well that Ends Well*, Act iv., Sc. 3.)

No one here present knows how soon he may be stricken down by mischief from one of the bye courts of Dublin which that Society might have prevented, if all those able to do it had joined its ranks, and given support to its organisation. You may have confidence in its working; with but small means it has already done much good. Help it by assisting to create a true public opinion upon sanitary matters in general, and thereby to save many lives and increase the welfare of the community.

Perhaps the most remarkable of all ancient proverbs are those which refer to strong drink. Moses forbade its use when the priests went into the House of God, and he states, when charging the Israelites before he left them, that they had not tasted wine or strong drink for forty years; and he commends them for their abstinence; though it is quite clear from other parts of the context that he did not regard the use of wine as a sin, for those who wished to indulge in the luxury. He did not prohibit it altogether, except to certain persons and at certain times. The Rechabites were commended, in the days of the Prophet Isaiah, more because they had kept their father's commandment, than simply for their abstinence. The wise are warned against its use in the Book of Proverbs, and its effects are very clearly put before the readers of that wonderful string of reflections and sage counsels, by one who evidently knew all about its effects.

It is, however, not until the days of Mahomet that we meet with a general acceptance of abstinence from wine and strong drink by great masses of people. I have very little doubt myself but that Mahomet's wonderful career was much influenced by his temperance maxims. By making abstinence from wine and strong drink a part of his religious tenets he was giving a proof of his intellectual superiority over those around him, and laying the foundation for his future greatness.

He had observed the helplessness of men when in their cups, and the weakness of their mental power the day after a debauch. He determined to strike a blow at such mental degradation by

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making the condition an impossible one among his lieutenants and devotees. In consequence of the dogma of abstinence, he and his followers became the superiors of the hordes of Arabia and eventually a terror to the more civilized but less temperate nations of the "Τον ουρανον," or Roman world. Mahomet, with his faith in one God, whom he regarded as a Being supreme, benevolent, and just, and having the dogma of total abstinence on his shield, was able to change the face of the moral world, and do much to purify it from the degradation into which it had fallen in the sixth and seventh centuries, in consequence of the luxury, the vice, and the intemperance, of a so-called civilisation. If he had abjured the use of the sword, if he had stuck to his articles of faith, and not done evil in order that good might come, and had not forced his views upon the people by the pouring out of human blood, if he had insisted upon the sacredness of human life under all circumstances, Mahommedanism might have been one of the greatest blessings the world had ever possessed, and it would have pre-prepared the way for Christianity in a most effectual manner. Cleanliness was a part of the Prophet's creed, and to this day it is observed, in a way, by the sons of Islam, though unfortunately it is not associated with a belief in infection. The habit of cleanliness is said even by Christians to be next to Godliness, though dreadfully forgotten even in Christian Schools and among Christian Communities; but we may be certain that no creed, no dogma, either religious or political, which does not inculcate the sacredness of human life, can long continue in the future to hold the mastery over the minds of men.

No other country or people, except Mahomedan races, have taken abstinence as one of their tenets until the days of Father Mathew. If either Celt or Saxon, or both, had done it, if the colonising power which belongs to both, had been strengthened by Mahomet's tenet of sobriety, what a different world we should have around us! The bitter cries which go up from the banks of the Thames, the Clyde and the Liffey, and from a greater part of this beautiful island, as well as from all parts of the world to which the trade of the United Kingdom extends, would have been shorn of much of their bitterness and intensity. Father Mathew's work was defective, and therefore evanescent, for it was misunderstood. He clearly enough put before the people that it was the drink which led men to do wrong, it was the drink which led men to starve their families, and ruin their health, and pour out their blood upon the earth; but it was not the detestation of their crimes which caused men to be abstainers, but because it led men to miss their mark, as was said when a total abstinence lecturer was asking an Irish audience as to the

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evils which the drink had done. "It led men," said the lecturer, "to shoot at their landlords," and, said a voice in the crowd, "to miss 'em;" it was not the disgust for the degradation caused by drink which led to Father Mathew's temporary success, but it was a desire to save money, which was used for other and unsatisfactory purposes, and as a consequence the movement has not been permanent. Is it not time to resuscitate Father Mathew's noble work upon a firmer basis, viz., one connected with the sacred character of human life? and to prevent that reflection, disgraceful to him who wrote it, which appeared the other day in the London *Times*, "That people generally would think it better that an Irishman should be addicted to whisky even in excess than that he should be skilful and successful in taking aim at a landlord from behind a hedge."

There is another sanitary work intimately connected with religious tenet, which I cannot pass by without referring to, viz., that of "fasting." Those were clear-headed observant men who instituted a fish dinner on Friday. The daily use of meat has its disadvantages, and sets up evils of a serious kind connected with gluttony, which the fathers of the Roman Catholic Church turned to good account when they made abstinence from meat on Friday a part of their religious duty. Fresh fish contains much of that material which renovates nerve matter, and assists to prevent its decay, whilst an interval of rest from strong meat enables the brain to become clearer for its Sunday work by giving time to the blood to be purified from excess of nitrogenous food. All honour to those men who used their knowledge to such good and such unselfish purposes. If all dogma had such foundations it would have been much better for the interests of the human race. But, at the present day (as well as in former times), it is too often used for selfish purposes, and for personal aggrandisement. Sanitary knowledge, however, is forcing itself upon the attention of all parties in the state, politicians are ready to take hold of it and use its arguments in their favour, if it will secure them a few votes at a given election; but as soon as the candidate obtains a seat in the House of Commons, or in any other elected body, the majority of sanitary reformers forget their pledges, and allow the evils which they promised to eradicate to go on eating into the vitals of the people.

Can we not do something to change this plan? Is it not time for politicians to shake hands over the measures which are called for, by sanitarians because they influence the health of the people? Why should not such measures be taken out of the range of politics, and put before the House and our town councils as non-political measures, to be judged upon their

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merits? Why should not Sanitary Bills be backed by the names of men on both sides of the House, although they are Government measures? Departmental Bills of this kind ought not to be impeded, blocked, or thrown out, simply because they have been introduced by a Liberal or a Conservative Secretary of State, as the case may be. The unpatriotic conduct of political men is much to be deplored, for it appears to those who watch the game from an unpolitical standpoint that place is of more importance than progress, and measures which are good in themselves must be opposed because they are brought in by the Government of the day. Ireland has suffered more for this action than has either of the sister countries, and the effrontery with which both political parties have been bidding in past years for the Irish vote, by pretending to be benevolent, has been most marked in offering to do something for Ireland, when they ought to have insisted upon the work, if it was necessary, being done by Ireland herself. This conduct has assisted to breed up a pauperised class, just as it has always done on the other side of the water, in those towns which have been cursed by a mistaken benevolence, which has so reduced a portion of the population as to lead them to be unable to assist themselves. Benevolence misapplied, as all political benevolence is sure to be, ruins the independence of a people, and tends to destroy that self-respect which can alone raise a nation to her proper place in the universe. Can we hope for much improvement in the health and morals of the people, either here or across the Channel, whilst such a plan is in the ascendant?

I am not arguing in favour of compulsion in sanitary work, I mean of governmental compulsion. I do not believe in the use of force for such purposes by a paternal government; but I would urge that whilst regarding "every man's house as his castle," in which he may do as he likes with himself, he has no right to crowd it up with inmates in excess of its capacity. There are limits in the power of so many cubic feet of air to sustain life in good health. When a man asserts his right to cram his house with too many occupants, the local authority, that is, your representatives on your local council, should be able and willing to set the proverb aside, and say to that man, you may smother yourself if you like, but you shall not smother your wife and family; you shall not decoy your neighbour in as a lodger, and deprive him of his health, and his country of his value as an operative! Overcrowding is at work in Dublin as well as elsewhere, and the great mortality which arises from this cause is produced by the desire to get rich at the expense of the life blood of the nation. No one can read the report of our President and his colleague regarding the sewerage and drainage of Dublin

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without being satisfied of its truth. "There is more money got by ill means than by good acts;" but the heaping together of money by men who crowd their hovels or their acres with more of their fellow creatures than the area can fairly accommodate, is one of the most debasing and brutal kinds of money getting, which should be put down by the strong arm of the law, put in force by public opinion. The municipal council chamber should vie with Imperial authority in crushing this canker, which strikes at the vitals of the commonwealth; and it becomes the duty of the State to see that the houses provided for the poor are not overcrowded, and are not imperfectly ventilated, that they can be kept clean and are well provided with that important necessary of life, pure water, and that waste and impurity can be rapidly removed from among the occupants. By its being the duty of the State, I mean the duty of the local authority armed with power conferred by the Imperial Government. Is Dublin doing her duty in this respect, are the inhabitants of this great city alive to the fact that the expenditure of money by the local authority will be repaid to them tenfold in the better health of her people? "There is that scattereth and yet increaseth, and there is that which withholdeth more than is meet, but it tendeth to poverty." (Prov. XI., v. 24). I have gladly learnt since I have been in Dublin that she is awakening to her responsibilities in this direction.

I wish I could have this proverb written in letters of gold in every council chamber in the kingdom, it ought to be before every man aspiring to be an alderman or councillor in every corporation, and as much in Dublin as anywhere else. With a death rate of 28 or 29 in the 1,000 it is evident to every sanitary reformer that someone is responsible "for withholding more than is meet" in this place.

The working men of Dublin are a power, here they can elect a majority of the representatives in the Council. Do they know what is meant by a death-rate? The town I reside in used to have a death-rate of 26 in the 1,000, it is now 16. That is, the lives of ten persons out of every 1,000 are preserved to their relatives who would, but for sanitary expenditure by the local authority and by private persons, be numbered with the majority every year. Let us suppose that the death-rate of Dublin were reduced from 28 to 16, it would mean that the funerals in the course of the year would be diminished by more than 3,000, a serious matter for the undertakers, still a trifle worth preventing. But it would also mean much more than this, for every death there are twenty cases of sickness, and if there are 3,000 fewer deaths, there would also be 60,000 fewer

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cases of sickness among the people every year. Let me ask the members of the benefit societies who happen to be present whether they can realise this fact, whether they can understand that for every death prevented there are twenty cases of sickness also prevented. Let us suppose that 20,000 of the working men of Dublin belong to benefit societies. They have to pay in weekly or monthly payments sufficient to provide for a sick fund; the greater the sickness, the more they have to provide from their earnings to meet it. If sickness is permanently reduced they will be able to permanently reduce their payments on this account. The 20,000 members will at present death-rates average at least ten days illness for each member in every year. If you diminish the death-rate you will also diminish the sick pay, (which has to be provided) and reduce it to an average of six days per year. If you bring it down to be equal to that of the town in which I reside, your 20,000 members will be saved from having to provide for 80,000 sick days' pay in each year. They will also have in their pockets the wages which they will have been able to earn in work, instead of the half-pay which sick-pay provides, and they will not have had to contribute so many levies for the extra funerals which the higher death-rate has levied upon them. I have quoted figures which vary in different years and at different seasons, and the deductions drawn from these figures will vary, but it is the principle I wish to inculcate and not to be mathematically correct. I am told also that benefit societies do not exist to any extent in Dublin. I can only say I am sorry for it.

Let me ask the working men now present if the proverb I have quoted is not one specially intended for their benefit, and that for their own sakes, as well as for that of their wives and families, they should take care to send men into the municipal council who will not be afraid of expenditure which is likely to be of the kind "that scattereth and yet increaseth."

That they should consider these local questions as of far greater importance than those political questions which but too often lead men to elect representatives because they belong to a particular political party, instead of being wise and thoughtful sanitary reformers. Party politics ought not to enter into the consideration of our local representatives, and any council elected on such lines will not be the best council for sanitary work.

Ask those who wish to represent you if they will take measures to prevent overcrowding among you; if they will take care that every house is provided with a supply of pure water at the lowest possible cost, or at the cost of the owner, and that there are houses which are fit for the poor to live in; if they

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will take care that waste and refuse be removed from your midst before it has time to set up mischiefs, similar to those which are now making themselves felt in the stinking towns of Southern France and Italy; ask them to insist upon the Liffey being restored to its pristine character, and not leave it any longer to be a "*cloaca maxina*," a great sewer, and as such a disgrace to the fairest city in the kingdom. It is curious to my mind to see how carefully some of our public men—local as well as imperial—seem to be wise in their own eyes, and yet fail to see that they are like the foolish virgins of Scripture, though the inference will force itself upon the mind of the thoughtful man that they only represent the public ideas. We are sending all over the world for phosphates and artificial manures, we are paying almost famine prices for meat and milk, whilst the very materials which should be turned into those articles are sent into the sea as food for fishes (which we don't catch, or, if they are caught, are not consumed), or are used for impeding the navigation into the docks and harbours of our great cities, or poisoning the inhabitants of our inland towns, or are destroyed as valueless. This observation applies to Glasgow, to Belfast, and to London as well as to Dublin. The town in which I reside does differently; the sewage is not sent into the sea, but it is returned to the land, as all sewage ought to be; it benefits the nation by growing green crops. Every acre under sewage cultivation can grow five times as much herbage as it did before it was so cultivated. There is five times as much meat and milk raised on that land as formerly used to be the case, and by so much has the tendency to meat famine been reduced.

If all the sewage of London had been treated in a similar way, sixty thousand head of cattle might have been raised and fed each year in addition to our usual home stock. This addition would have made us by so much the less dependent upon foreigners for our meat supply, and have made a larger market for the young stock of the sister country. The inhabitants of London prefer to throw their refuse into the river Thames, to poison their neighbours lower down the stream, to damage their harbour, and so prepare for the time when the shipping trade of London will become impossible. The question is raised by narrow utilitarians as to whether sewage utilisation will pay. Patentees and company mongers join the cry, and prevent the progress of this great work.

I have so often urged that it is not a question as to the payment for this or that particular year, or this or that particular outlay, but that in the end a national benefit results which will pay ten times over more handsomely than it is possible for the river Thames or the Liffey to do by being

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transformed into an immense sewer. Sewage irrigation has outlived the outcry made against it that it was a sanitary danger; it has been shown most conclusively that it is perfectly free from such evil. It has been shown that the produce from it can vie with any produce as to its goodness and commercial value, and that wherever there are people to produce sewage, there is a market for that produce. More than 100,000,000 gallons of water are daily abstracted from the collecting grounds of the Upper Thames; they are used in washing the people and flushing away their refuse into the drains of London, and are then, with the collected mass of filth, sent down to Crossness and Barking to poison the lower reaches of the river, and gradually produce a state of things which will make the future sanitary history of that river somewhat similar to that which now belongs to the Pontine Marshes or the Deltas of the great rivers of India, whilst the bed of the Thames above the metropolis is being deprived of its proper water from the deep springs which ought to supply it.

It is now a question of money, but in the end it will be a question of vital importance to London. It is one which has no political significance like a Turkish or an Egyptian loan, and there is no palm oil belonging to its promotion. The 100,000,000 gallons of water fouled by the filth of London ought to be returned to the land from whence the water came, and ought to be again filtered through the Chalk Hills, the Woking and other sand beds, or the barren acres of Surrey, Hants, Berks, and Oxfordshire, by which tens of thousands of cattle might be nourished, and millions of gallons of milk provided for the teeming population of the great metropolis of the Empire, and so render them less liable to the incidence of that meat famine which will come whenever the foreign markets are closed to our merchants and shippers. Those acres are not now worth 5s. per annum. If they were supplied with the sewage of London, they would be agriculturally worth at least £5 per annum, but an "Englishman's house is his castle;" his country may want meat and milk, but it must not grow these articles near to his broad acres, though it contains his countrymen's diet, and may be the means of saving them from the chances of starvation in some future time. The ideal damage which such a use is supposed to produce is enough to stop a national benefit, and prevent the carrying out of those works which would transfer the barren ranges of hills to the north-west and south-west of London into fruitful fields, and fill the river Thames in the driest season with a healthy flood of waters. The sanitarian has a duty to perform in addition to the saving of life; he must take care to prevent his

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work from bringing about a result which will come if an increasing people be not properly fed. He is able to show you that Lord Palmerston's saying is perfectly true, viz., that "filth is but matter in the wrong place, and that if it be transferred in a proper form, and in a proper manner, to its proper place, it will provide food for the people." Yet we allow it to go to waste or we promote measures to render it valueless, and so misuse our noiseless highways in a way which must render them in the early future as noisome as the Tiber became to the inhabitants of ancient Rome.

I would urge upon the inhabitants of this beautiful city that they rest not until the sewage is taken out of the Liffey, and sent to its proper destination, viz., to the land which wants it; that they rest not until the inhabitants in their close quarters have more breathing space among them. That water should be available for every boy and girl, as well as every man and woman wanting it, without stint, and that the pure air from your native hills shall not be fouled with noisome impurities as soon as it reaches the precincts of your city. You will then have paved the way by which health may be secured, and a happy and long life be yours, for "national health is national wealth." Recollect, however, that "cleansing a blot with blotted fingers maketh a greater." The first principle of sanitary work must be carried out in the individual house. The householder must desire a healthy home, and to have it he must purify the governing body from the presence of those who prefer an unhealthy people.

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CLOSING GENERAL MEETING AND BANQUET.

The closing General Meeting of the Congress was held on Friday afternoon, October 3rd, after the close of the sectional meetings. The President, Sir Robert Rawlinson, C.B., in the chair, supported by the Lord Mayor and the Chairman of Council of the Institute.

Among the subjects brought before the Congress may be noted the Inaugural Address by Sir Robert Rawlinson, which dwelt largely upon the question of cholera, and generally upon the water supply and drainage of towns and houses, and question of sewage disposal. The address to Section I., by Dr. T. W. Grimshaw, on Statistical Measures of the Health of Communities, contains a number of valuable tables of death-rate and population, with remarks upon their value and modes of application.

The overcrowding and insanitary state of small Irish towns were described in a paper by Surgeon-Major J. Wycliffe Jones, and in a long paper by Mr. Edward Spencer, on the Homes of the Working Classes in Dublin, in which he gives a descriptive account of the principal provisions of all the Acts relating to the Dwellings of the Working Classes in Ireland, the way in which this problem had been dealt with in Dublin. Cholera, besides being mentioned in Sir Robert Rawlinson's address, was also brought forward in a paper by Surgeon-General A. C. C. De Renzy, and led to considerable discussion.

Ambulance work and Hospital construction also received consideration in papers by Mr. V. B. Barrington Kennett in Section 1, and Mr. Howard Pentland in Section II.

The President's address, by Mr. C. P. Cotton, dealt principally with the question of loans for Sanitary purposes, and the general question of Water Supply and Sewerage; the question of Water Supply in Ireland was further amplified in a paper by Dr. C. A. Cameron (Section III.), and in a paper by Dr. F. F. MacCabe (Section II.) and Professor Hull (Section III.).

Public Cleansing and the Collection of House Refuse were dealt with in papers by Mr. W. Eassie and Mr. James Young, and also in a paper on Blood-drying (Section III.).

The important subjects of Sewage Disposal, the Ventilation of Sewers, and Sewerage and House Drainage generally, occupied the attention of a large part of the Section and many valuable papers were read, followed by important discussions. The Sanitary Advantages of Electric Light were considered in a paper by J. Angelo Fahie.

Dr. Cameron's address to Section III. gave a comprehensive

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description of Parasites and Bacteria in animals and substances used for food, and the diseases that are produced by their organisms.

The influence of food on health, Rainfall, and Geology, were brought under the notice of the Section, and the meeting concluded with a paper on Ventilation.

The lecture to the Congress on Thursday evening, by Dr. A. Carpenter, included a very wide range of subjects treated in a rather popular way, as the lecture was intended partly for the working classes, a large number of whom were present.

The Banquet held on Thursday will always be memorable, as illustrating how entirely the work of the Institute interests the whole community, and can be considered apart from any party or political distinction; His Excellency the Lord Lieutenant and the Lord Mayor both being present, to express their interest in the work, and to lend their encouragement to aid in furthering the objects of the Institute.

The PRESIDENT, in proposing "The health of her Majesty the Queen," said—I have the honour to propose a toast honoured wherever the English tongue is spoken—that of her gracious Majesty the Queen. It is a toast which needs no eulogy on my part, as her Majesty has made herself beloved by all who have had the pleasure of hearing her name mentioned. I now, therefore, propose "The health of her Majesty the Queen of Great Britain and Ireland."

The toast was drunk with very great enthusiasm and cheering.

The PRESIDENT next, gave "The health of his Excellency the Lord Lieutenant, and Prosperity to Ireland." He said—I have the honour to propose the health of his Excellency the Lord Lieutenant, who has been pleased to grace with his presence this Sanitary Congress of Great Britain. I have had the privilege of knowing his Excellency for some years. I know him to be a profound sanitarian. He has shown this by the house drainage and sewerage works which he has caused to be executed. I know he takes a deep interest in the object that this Congress is formed to promote. He has carried out to perfection the best sanitary works he could devise in his own residence, Spencer House, St. James's, and he has also set splendid examples on his own estate in Northamptonshire, on his farms, and in his villages, and we are very proud indeed to be honoured by his presence on this occasion. On behalf of the association, I can only wish his Excellency health, long life, and prosperity.

The toast was drunk amidst continued cheering.

The LORD LIEUTENANT.—I thank you extremely for the very cordial way in which you have received this toast. My old friend

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Sir Robert Rawlinson has been too flattering in his observations with regard to what I have done for sanitary science; but I assure you that I feel a very deep and great interest in the work which you have in hand; and I was exceedingly glad to be able to accept your hospitality here to-night to show the interest which I take in your society, and especially in your visit to Dublin. We are living in an age when all kinds of new sciences have been, if I may use the word, invented. Learned men have been laying down principles, and drawing up into a code the observations and experiences which they have of matters which occur in our busy towns and in our daily life; but I will venture to say that no more useful science has been found for the people of the United Kingdom than the hygienic or sanitary science which your association represents so worthily to-night. No one, I think, can have visited that very popular place in London—I mean the Health Exhibition—without seeing how very wide indeed is the range which your society covers. It is almost impossible to find any subject omitted if you go round that interesting and valuable exhibition. You find food and drinks which are good for health; you find models of houses, their drainage, and the best hints for their fitting up; and if you go farther you may see the highest works of art, for mental influences as well as physical influences have to do with health. You may see also not only such matters as those to which I refer, but the extravagances which the vanities of men and women have devised in dress. You may see the sad results of the endeavour to get a very slight waist. You may see what will attend the efforts of men to wear extremely narrow pointed boots. There is nothing in fact which a sanitary exhibition may not embrace within its doors. But I shall not attempt to define your work. That would be almost too difficult for so experienced and wise a man as my friend on the left (Sir Robert Rawlinson). I know this—that it has a most useful and beneficial effect on all grades of society, from the richest to the poorest, and that it has admirable influence in promoting the health and also the wealth of the people. I would notice, however, some things which are striking us every day. No one can have failed to observe within the last few months the terrible devastations which the epidemic of cholera has caused in various parts of the South of Europe. Every day we have read with deep interest and concern the progress of that terrible malady. We have seen it in France; we have seen it in Italy; and we know that when that terrible disease breaks out the doctors' and physicians' skill cannot effectually keep down the enormous death-rate. It is to prevention, —to sanitary science that we have more especially to look for the prevention of the spread of that terrible scourge. Wherever there are most victims, you will be sure to find one of three things. Either there is overcrowding in the dwellings, bad drainage, or an insufficient and impure water supply. It is to sanitary science we have to look to ward off and keep away from our shores and our dwellings this disease. We have not had it yet in England or in Ireland. I trust it may be kept away, but I think we ought to take a lesson and a warning from what has occurred,

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and adopt those measures which, if the disease should unfortunately come amongst us another year, would remove those circumstances which so enormously accelerate the death-rate when the disease breaks out in a populous city. We all know that in every city there are great difficulties to contend with in regard to sanitary arrangements. London has its Thames, and I think no one will deny that Dublin has its Liffey. When I first came to reside in this country nearly fourteen years ago, the question of the purification of the Liffey was prominent. It is so still. It is a very difficult subject; but if the Corporation and those who have the charge of the sanitary measures of this city, are enabled—and I hope they may be some day—to carry out this great but difficult work, and with it the improvements of the dwellings of the poor, which is very greatly needed in this city, we may hope that if that terrible scourge comes it may not find many victims among the poor here. Dublin has some great advantages; it is blessed with fine open spaces—some of them dedicated to the public by the munificence of some of your citizens—large open places close to the very centre of the densest population. You have the Phœnix Park also, which is a splendid place for the recreation and health of the people. In these respects you are very fortunate; and in one most important respect you are probably more fortunate than London and many other large towns. I allude to the admirable water supply. I believe that no greater blessing has been conferred on the people of Dublin than the establishment of the Vartry works, and the plentiful supply of that water to all parts of Dublin. These works are always associated with the name of Sir John Gray. Sir John Gray was a gentleman who had no mean success in politics, but I will venture to say that there will be no nobler work or greater honour attached to his name than that of securing for the people of Dublin the benefit of the purest and most plentiful supply of water. We who have to do with politics cannot help thinking of the influence which legislative measures must have on the work with which your Association is connected. I am happy to say that within the last ten or twelve years improvements have been made with regard to legislation on local matters. I remember the time when it was almost impossible, not only on account of expense, but also on account of delays, to get any great work, such as a gas or water bill, carried through Parliament. It was a very costly affair and a very tardy one. Now, I am happy to say that by means of legislation and provisional orders these matters may be dealt with comparatively cheaply and quickly. I sincerely wish we could get through certain matters more promptly that still have to go before Parliament. I almost despair, however, of anything of the sort. Last year I was rash enough to try to carry a bill to enable the Corporation of Dublin to obtain the means of enlarging their own powers and getting important considerations settled, and I was also rash enough to express a hope that we might carry the measure through Parliament that year; but such was the pressure of business in the House of Commons that it was impossible to introduce the bill, and I regret it most deeply, and sincerely hope

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that next year we may be more successful. There have, however, been many other measures passed which have contributed a great deal to remove the difficulties with regard to the improvement of the sanitary condition of the country. I believe that in Dublin the Corporation (though it has not been able to drain the Liffey), has done a great deal, by providing baths, by relieving the densely crowded parts of the city, by promoting the building of better houses for the poor, through the Artizans' Dwellings Act, and in many other marked ways. In other parts of the country much has also been effected. Of course in a country which is much poorer than the sister country you cannot expect that local bodies will take up so widely large operations, which cost a great deal of money; but since the Sanitary Acts were passed (1874 and 1878) nearly £1,200,000 has been borrowed and expended by local bodies for the improvement of drainage and water supply, and in the rural districts during the last two years £50,000 has been expended in various sanitary improvements. Wells have been sunk, and proper water supply provided in various places. I must not forget to mention one important Act passed last year, which was an Act on a principle never adopted in England—the Labourers' Act. That Act has already been in operation, but only for about a year. Still, during that time the Local Government Board have been applied to for sixty-nine provisional orders, and already the building of over 3,000 houses has been sanctioned under it. When we consider how very bad the houses and cottages of the poor in various parts of Ireland are, I think we may look forward to a very great change in the moral character of the people as well as in their social and sanitary condition, if this Act continues to operate throughout the country. Last year a committee sat to inquire how the Act was working, and I hope, from what I hear, that various amendments may, on the recommendation of that committee, still further help its operation. I have to thank you exceedingly for the kind attention that you have paid to my few remarks. But before I sit down I have to propose an important toast. It is that of the Sanitary Congress, coupled with the name of its president, Sir Robert Rawlinson. I need not dwell at greater length than I have on the useful operations which your society carries out, and I am quite certain that the importance of its work cannot be exaggerated. Your excellent president is an old friend of my own. He has been good enough to refer to public works which we have done together. I have official acquaintance with Sir Robert Rawlinson from having had measures under my care connected with his department. I know how able he is, and with what judgment and with what energy he approaches difficult subjects with which he has to deal. I think I can allude here to the admirable way in which he presided over and carried through the work of a commission which came here in 1879. I believe that he carried it through with the greatest possible satisfaction to all who were concerned. I have the greatest possible pleasure, therefore, in proposing to you the "Sanitary Congress," coupled with the name of its president, Sir Robert Rawlinson.

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The PRESIDENT (Sir Robert Rawlinson), in reply thanked his Excellency for the kind manner in which he had proposed the toast, and the company for the way in which they had received it. He himself was but a very humble servant in the cause of sanitary reform. It was true that he was one of the first inspectors appointed under the first Public Health Act in 1848, which was carried by a former Lord Lieutenant of Ireland, then Lord Morpeth. He made the first inspection and wrote the first report under that Act—and now he stood the solitary and sole inspector serving under the Government connected with that Act, which first introduced sanitary measures, as they were now prosecuted in this country. He had striven to the uttermost of his power to be useful in his day and generation. His occupations had been very various. He had been sent out by her Majesty's Government to aid their suffering army in the Crimea, and he had been subsequently sent to do what he could to find labour for the distressed men during the cotton famine in Lancashire. His Excellency had told them that in 1879, he (Sir Robert) was sent to make inquiries as to the sanitary condition of Dublin and the purification of the Liffey. He now stood before them as President of the Sanitary Congress, and he thanked them most sincerely for the honour they had done him.

THE PRESIDENT next proposed the toast of the "Lord Mayor." The Sanitary Institute of Great Britain had great cause to thank his Lordship for the kind attention which he had shown them during this week in Dublin. His Lordship had evinced the interest he felt in the work of the Institute since it came to Dublin, and he (the President) knew the company would join him in drinking to the health, prosperity, and long life of the Lord Mayor of Dublin.

The toast was cordially drunk.

The LORD MAYOR, in responding, said that as head of the municipality he felt very great pleasure, indeed, in promoting, so far as in him lay, the objects which had brought the Sanitary Institute of Great Britain to Dublin. The Municipal Council of Dublin had very many difficulties to contend with. In reference to the purification of the Liffey, it would be in the recollection of Sir Robert Rawlinson that the Corporation was most anxious to accomplish that work, but found that the tenders sent in ranged from £500,000 up to nearly a million, and, as prudent men, the Council did not feel warranted in incurring so large an expenditure, particularly as there were other municipalities which would be equal participators in its benefits, but would bear no portion of its cost. He thought the particular circumstances of Dublin would warrant the Government in taking up this question and passing a bill to amalgamate the townoutships with the city. So anxious was the Corporation for carrying out the purification of the Liffey, that the question had again been taken up, and the Chief Engineer and the Chief Officer of Health had been instructed to report upon the most satisfactory method of accomplishing it.

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The LORD MAYOR proposed "The Sanitary Institute of Great Britain," coupled with the name of Dr. Carpenter, who responded.

Dr. ALFRED CARPENTER said that the Institute was trying to remove two very important difficulties which stood in the way of success. The first difficulty was one that arose from the gross ignorance of the people as to what was true sanitary science. Now, one great object of the Institute in going from place to place was to teach the people what was true sanitary work, and for that purpose the exhibition was organised. Another object was the instruction of official workers, so that local authorities would be enabled to appoint inspectors of nuisances and surveyors who having obtained the certificate of the Examiners of the Sanitary Institute, were men who were proved to have a thorough knowledge of the first principles of sanitary science, and were not merely appointed because they were friends of town commissioners or boards of guardians. The Institute aimed at popularising the truths of sanitary science. He thanked his Excellency on behalf of the Institute for his attendance, and he also took that opportunity of thanking the Lord Mayor for the trouble he had taken to remove difficulties that had existed, and bring the Congress to a very satisfactory issue, and which but for that assistance would have jeopardised the Congress.

Dr. GRIMSHAW (the Registrar-General) proposed the toast of "The Judges," and said he thought he was right in stating that the Health Exhibition at Ball's Bridge was the largest ever held under the auspices of the Sanitary Institute.

Professor CORFIELD responded, and said that the object of the awards was that they should be a real guide as to what was valuable in sanitary science. No awards were given without the exhibits being practically tested, and no reliance was placed on models so far as the granting of prizes was concerned.

Dr. CARPENTER proposed "The Local Committees," to which Mr. Maguire responded, and acknowledged the valuable help received from the members of the medical profession. Without the aid of Mr. Edward Spencer, the Assistant Secretary, they could not have had so great success.

Dr. CARPENTER said he had been directed by the President to say that the arrangements connected with the banquet had been carried out by Dr. Duffey. The President had requested him to say that he as well as the Council tendered to that gentleman their grateful thanks for all that he had done to promote their enjoyment, and to give them the very pleasant and enjoyable evening that they had had the privilege of spending.

Dr. DUFFEY's health was then drunk with much cordiality, and that gentleman briefly acknowledged the compliment.

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SUPPLEMENTARY REPORT OF THE JUDGES ON THE EXHIBITS DEFERRED FOR FURTHER PRACTICAL TRIAL.

GLASGOW, 1883.

Out of the forty-four exhibits deferred for further practical trial, as mentioned in the Report, the following were submitted by the exhibitors:—

WOOLLAMS, W., & Co., *London*, Pigments and Paper Hangings.
BOROUGH LEATHER WAREHOUSE COMPANY, *London*, Crocodile Hide Leather.
GARDNER, A., & SON, *Glasgow*, Preserved Timber.
HILDESHEIM, J., *Glasgow*, Dicks' L'Extincteur.
BOULNOIS, H. P., *Portsmouth*, Acme Sewer Pipes.
HARRISSON, T. HARNETT, *Liverpool*, Improved Collar-joint.
EMPTAGE, D., *Margate*, Round Pipe Traps.
BACON, J. L., & Co., *London*, Hot Water Apparatus.
SINCLAIR, G., *Leith*, Mechanical Stoker.
BRADBURY & Co., *Oldham*, Sewing Machines.
SINGER MANUFACTURING COMPANY, *London*, Sewing Machines.
GROSVENOR, F., *Glasgow*, Filters.
HENDERSON, O., *Glasgow*, Silicated Carbon Filters.
*MAIGNEN, P. A., *London*, Anti-Calcareous Powders.
BEVERIDGE & Co., *Glasgow*, Pickles, Sauces, and Essence of Coffee.
CONDENSED MILK Co., *Limerick*, Condensed Milk.
IRVINE & Co., *Gateshead-on-Tyne*, Mustard.
INDIAN TEA Co., *Glasgow*, Indian Tea.
SCOTT, A. & R., *Glasgow*, Oat-flour.
CALVERT, F. C., & Co., *Manchester*, 50 % Carbolic Disinfecting Powder.
RIMMEL, EUGENE, *London*, Aromatic Ozonizer.
WHEELER, J., *Ilfracombe*, Pixene.

We recommend that Medals and Special Certificate be awarded to the undermentioned exhibitors:—

BOULNOIS, H., PERCY, *Portsmouth*, for "Acme" Sewer Pipes.
SINCLAIR, G., *Leith*, for Mechanical Stoker.
SINGER MANUFACTURING COMPANY, *London*, for Friction Driving Attachment for Sewing Machines.

* See note at end of Report on next page.

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(SPECIAL CERTIFICATE).

WOOLLAMS, W. & Co., *London*, for Non-Arsenical Pigments and Paper Hangings.

We also recommend that Certificates of Merit be awarded to the undermentioned exhibitors:—

BOROUGH LEATHER WAREHOUSE COMPANY, *London*, for Crocodile Hide Leather.
GARDNER, A., & SON, *Glasgow*, for Method of Rendering Timber Non-Inflammable.
HILDESHEIM, J., *Glasgow*, for Dicks' L'Extincteur.
HARRISSON, T. HARNETT, *Liverpool*, for Improved Method of Connecting Lead Pipes with Stoneware Pipes.
BRADBURY & Co., *Oldham*, for Revolving Shuttle for Sewing Machines.
BEVERIDGE & Co., *Glasgow*, for Pickles and Sauces.
IRVINE & Co., *Gateshead*, for Mustard.
INDIAN TEA COMPANY, *Glasgow*, for Indian Tea.
SCOTT, A. & R., *Glasgow*, for Midlothian Oat-flour.
CALVERT, F. C., & Co., *Manchester*, for 50 % Carbolic Disinfecting Powder.
WHEELER, J., *Ilfracombe*, for "Pixene."

* We have not yet had sufficient opportunity of testing the exhibit marked with an asterisk, and it is therefore of necessity deferred for a future Report.

We regret that we are unable to recommend the award of the Richardson Medal.

W. H. CORFIELD, M.A., M.D., OXON, CHAIRMAN.
H. C. BARTLETT, PH.D., F.C.S.
F. S. B. F. DE CHAUMONT, M.D., F.R.S.
ROGERS FIELD, B.A., M.INST.C.E.
HENRY LAW, M.INST.C.E.
J. WALLACE PEGGS, A.M.INST.C.E.
H. SAXON SNELL, F.R.I.B.A.
ERNEST TURNER, F.R.I.B.A.

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REPORT OF THE JUDGES OF THE EXHIBITION, DUBLIN, 1884.

We, the undersigned, the Judges appointed by the Council, beg leave to recommend to the Council the following distribution of Medals and Special Certificates, and of Certificates of Merit.

Exhibits which have already received Medals at previous Exhibitions of the Institute are excluded from awards of Medals, but those Exhibits to which a second Medal would otherwise be awarded receive Special Certificates, and these are distinguished in the following list by asterisks.

SILVER MEDAL OFFERED BY THE EXETER GAS COMPANY.

WRIGHT, J., & Co., *Birmingham*, for Eureka Gas Cooking Stove.

MEDALS AND SPECIAL CERTIFICATES.

We recommend that Medals or Special Certificates be awarded to the undermentioned exhibitors:—

CLASS I.—BUILDING MATERIALS, CONSTRUCTION AND MACHINERY.

*BRADFORD & Co., *London*, for Washing Machines.
DOULTON & Co., *London*, for Art Pottery.

CLASS II.—WATER SUPPLY AND SEWERAGE.

*BRITISH SANITARY Co., *Glasgow*, for Self-acting Earth Closets.
CRAIG, J. & M., *Kilmarnock*, *N.B.*, for Enamelled Fireclay Sinks.
*DOULTON & Co., *London*, for Anti-Percussion High Pressure Valves.
*HEAP, R. R., *Manchester*, for Dry Earth or Ashes Closet.
MAGUIRE & SON, *Dublin*, for their exhibit of Sanitary and Domestic Appliances.
SHANKS & Co., *Barrhead*, *N.B.*, for Siphon-action Water Waste Preventers.

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CLASS III.—HEATING, LIGHTING, AND VENTILATING.

*Doulton & Co., *London*, for Ventilating Tile Stove.
Edmundson, J., & Co., *Dublin*, for exhibit of Swann's Electric Lamps.
*Ellison J. E., *Leeds*, for Conical Ventilators.
Musgrave & Co., *Belfast*, for Slow Combustion Stoves.
*Smallman, John L., *Dublin*, for Stott's Mercury Gas Governor.
*Wilson Engineering Co., *London*, for the Wilson Cooking Range.
Wright, J., & Co., *Birmingham*, for Eureka Gas Cooking Stove.

CLASS IV.—PERSONAL HYGIENE, FOODS, FILTERS, AND DISINFECTANTS.

Burroughs, Wellcome & Co., *London*, for Powders for Peptonising Milk.
*Calvert, F. C., & Co., *Manchester*, for Carbolic Acid and preparations of it.
*Chorlton & Dugdale, *Manchester*, for Excelsior Spring Mattress.
Chorlton & Dugdale, *Manchester*, for "Swing" Woven Wire Mattress.
Donegal Industrial Fund, for Innocuously-dyed Woollen Goods.
Mackey, Mackey, & Co., *London*, for Chemicals used for Disinfection.
*Maignen, P. A., *London*, for Filtre Rapide.
Pim Bros., *Dublin*, for exhibit of Furniture.
Rothwell, W., *Bolton*, for Flat Web Knitting Machine, and Rothwell Knitting Machines.

CERTIFICATES OF MERIT.

We further recommend that Certificates of Merit be awarded to the undermentioned Exhibitors:—

CLASS I.—BUILDING MATERIALS, CONSTRUCTION AND MACHINERY.

Adams, Robert, *London*, for the Norton Door Spring.
Adams, Robert, *London*, for Adjustable Pivot for Fanlights.
Bourtreehill Coal Co., for White Enamelled Bricks.
Cadle, C., *Dublin*, for Silicate Cotton Composition for covering Steam-Pipes.
Carson, W., & Sons, *Dublin*, for Willesden Waterproof Paper and Canvas.
Cordingley, T., & Sons, *Bradford*, for Granite Concrete Pavement.
Craig, J. & M., *Kilmarnock*, for White Enamelled Bricks.
Doulton & Co., Lambeth, *London*, for Silicon Tread for Steps.
Maguire & Son, *Dublin*, for Marsden Tiling for Wall Decoration.
Pennycook Patent Glazing and Engineering Co., *Glasgow*, for their System of Glazing without Putty.
Scott, F. R., & Co., *Dublin*, for Solid Oak Parquet Flooring.
Wilby, W., *Dublin*, for Chain Belting for Machinery.

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CLASS II.—WATER SUPPLY AND SEWERAGE.

BAIRD, W., *Dublin*, for Butler's Sink, lined with Block Tin.
BAIRD, W., *Dublin*, for White Enamelled Fireclay Sinks.
BAIRD, W., *Dublin*, for Bath, with Shower Douche and Spray Fittings combined.
BAIRD, W., *Dublin*, for Lavatory, with Shampooing Apparatus.
BAIRD, W., *Dublin*, for Hydraulic Ram.
BAIRD, W., *Dublin*, for Horizontal-Pull Fittings for Baths and Lavatories.
BAIRD, THOMPSON, & Co., *Glasgow*, for Watts's Asphyxiator for Testing Drains with Smoke.
BOURTREEHILL COAL Co., Dreghorn, *Ayrshire*, for Stoneware Drain Pipes.
BOURTREEHILL COAL Co., Dreghorn, *Ayrshire*, for White Enamelled Fireclay Sinks.
CRAIG, J. & M., *Kilmarnock*, for Buchan's Disconnecting Trap.
DOULTON & Co., Lambeth, *London*, for Vacuum Flushing Cistern for Water-Closets, with Seat-action Arrangement.
DOULTON & Co., Lambeth, *London*, for Cheap Glazed Stoneware Sinks.
DOULTON & Co., Lambeth, *London*, for Locking Apparatus for Bath-Fittings.
DOULTON & Co., Lambeth, *London*, for Lambeth Combination Water-closet.
DOULTON & Co., Lambeth, *London*, for Enamelled Ware Open Channels for Manholes.
DOULTON & Co., Lambeth, *London*, for Manhole for Drains, with connections complete.
DOULTON & Co., Lambeth, *London*, for London-made Stoneware Pipes.
MAGUIRE & SON, *Dublin*, for White Enamelled Fireclay Sinks.
MAGUIRE & SON, *Dublin*, for Cast-iron Drain Pipes, coated with Angus Smith's Preparation.
SHANKS & Co., *Glasgow*, for Cast Iron Baths.
SHANKS & Co., *Glasgow*, for Porcelain Lavatories.
TWYFORD, T., *Hanley*, for Lavatory Basins.
TWYFORD, T., *Hanley*, for Slop Sinks.
TWYFORD, T., *Hanley*, India-Rubber Connection for joining flushing pipe to W.C. Basin.

CLASS III.—HEATING, LIGHTING, AND VENTILATING.

ARDEN HILL & Co., *Birmingham*, for Gas Cooking Stove, lined with White Tiles.
CARSON, W., & SONS, *Dublin*, for Tortoise Slow Combustion Stoves.
DOULTON & Co., Lambeth, *London*, for Glazed Ware Mantelpiece, with Slow Combustion Grate.
ELLISON, J. E., *Leeds*, for Radiator Ventilator.

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KITE & Co., *London*, for Noiseless Chimney Breast Outlet Ventilator.
KITE & Co., *London*, for Wall Inlet Ventilator.
LEGGOTT, W. & R., *Bradford*, for Opener for Fanlights and Skylights.
MAGUIRE & SON, *Dublin*, for New Laundry Stove and Copper Boiler.
WRIGHT, J., & Co., *Birmingham*, for Ventilating open Gas Fire.

CLASS IV.—PERSONAL HYGIENE, FOODS, FILTERS, AND DISINFECTANTS.

BILLINGTON BROS., *Liverpool*, for Portable Bed, with Liverpool Spring Mattress.
BOYD, S., *Dublin*, for Soaps.
BOYD, S., *Dublin*, for Chemicals used in Disinfection.
BURROUGHS, WELLCOME, & Co., *London*, for Absorbent Cotton and Antiseptic Sponges.
CALVERT, F. C., & Co., *Manchester*, for Carbolic Soaps.
CALVERT, F. C., & Co., *Manchester*, for Soluble Cresol.
CARSON, W., & SONS, *Dublin*, for their exhibit of Tricycles.
CHORLTON & DUGDALE, *Manchester*, for Hospital Bed, fitted with Raising Appliances.
CHORLTON & DUGDALE, *Manchester*, for Pitch Pine Lath Mattress.
CHORLTON & DUGDALE, *Manchester*, for Hospital Bed, with New Spring Mattress.
DUBLIN AND WICKLOW MANURE Co., for Alum Cake.
ELVERY, J. W. & Co., *Dublin*, for Gentlemen's Ventilated Waterproof Overcoats.
FLEMING, W., *Dublin*, for the Combination Bedstead.
FLETCHER BROS., *Dublin*, for exhibit of Tricycles.
GRAHAM, W., *Dublin*, for Ventilated Hats.
GROOM & Co., *London*, for Bower's Potato Steamer.
GROOM & Co., *London*, for Self-Indicating Tea or Coffee Infuser.
HARRISON PATENT KNITTING MACHINE Co., *Manchester*, for Knitting Machines.
HOTBLACK, J., & SONS, *Norwich*, for an Improved Shape of Boot.
JEYE'S SANITARY COMPOUND Co., *London*, for Jeye's Perfect Purifier.
MAGUIRE & SON, *Dublin*, for Scott's Self-regulating Disinfecting Chamber.
MORGAN, J., *Dublin*, for Pith Helmet.
PEARSON & Co., *Dublin*, for the Institution Bed with Woven-Wire Mattress.
PIM BROS. LIMITED, *Dublin*, for the Victoria Knitting Machine.
PIM BROS., *Dublin*, for the Hinged Cot.
SCOTT & Co., *Dublin*, for exhibit of Furniture.
SHORT, PATRICK, *Dublin*, for the Rhinoceros Hide "S" Boot.
TYRRELL, BROOKE, *Dublin*, for exhibit of Furs.
WEBB, A., *Dublin*, for the "Natural" Boot for Ladies.
WHEELER, J., *Ilfracombe*, for Pixene.

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CLASS V.—ARTICLES OF SANITARY INTEREST NOT INCLUDED IN THE ABOVE CLASSES.

ELVERY, J. W. & Co., *Dublin*, for the Leander Life Belt.
SMITH, ELDER, & Co., *London*, for Sanitary Publications.
STEPHENSON & TRAVIS, *Liverpool*, for Stypium Absorbent Antiseptic Surgical Dressings.

EXHIBITS SELECTED FOR FURTHER PRACTICAL TRIAL.

With regard to the following Exhibits the Judges are unable to give their decisions until they have submitted the Exhibits to a more complete and extended practical examination than is possible at the Exhibition:—

CLASS I.—BUILDING MATERIALS, CONSTRUCTION AND MACHINERY.

CADLE, C., *Dublin*, Cotton Machine Belting.
CARSON, W., & SONS, *Dublin*, Anti-corrosion and other Paints.
DOCKRELL, F., & SONS, *Dublin*, Cheap Artistic Non-poisonous and Washable Wall Papers
GANDY, MAURICE, *London*, Cotton Machine Belting.

CLASS II.—WATER SUPPLY AND SEWERAGE.

BAIRD, WILLIAM, *Dublin*, Turbine Wheels.
BOURTREEHILL COAL CO., *Dreghorn, Ayrshire, N.B.*, White Enamelled Fireclay Laundry Trough.
CADLE, C., *Dublin*, Double Turbine Water Wheel.
CRAIG, J. & M.. *Kilmarnock*, Shield's Flush-out Water-closet.
CRAIG, J. & M., *Kilmarnock*, White Enamelled Fireclay Laundry Trough.
DOULTON & Co., *London*, Automatic Flushing Tanks.
DOULTON & Co., *London*, Waste-preventing Valve for Water-closets.
DOULTON & Co., *London*, Automatic Flusher for Urinals.
DOULTON & Co., *London*, Jointed Tested Pipes.
DOULTON & Co., *London*, Grease Interceptors.
MAGUIRE & SON, *Dublin*, Safety Joint Drains.
MAGUIRE & SON, *Dublin*, White Enamelled Fire-clay Laundry Trough.
MAGUIRE & SON, *Dublin*, Sanitary Reform Universal Water-closet.
MAGUIRE & SON, *Dublin*, Wilcocks' Automatic Flushing Closet.
MAIGNEN, P. A., *London*, Process for Softening Water.

CLASS III.—HEATING, LIGHTING, AND VENTILATING.

BACON, J. L., & Co., *London*, Heating Apparatus.
CADLE, C., *Dublin*, Blackman Air Propeller.
WENHAM'S PATENT GAS LAMP COMPANY, *London*, Regenerative Gas Burner.

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WILSON ENGINEERING COMPANY, *London*, System of Utilising the Waste Heat from Cooking Ranges.

CLASS IV.—PERSONAL HYGIENE, FOODS, FILTERS, AND DISINFECTANTS.

BENSDORP & Co., *London*, Soluble Dutch Cocoa.
BURROUGHS & WELLCOME, *London*, Kepler's Extract of Malt, and ditto with combinations.
CANTRELL & COCHRANE, *Dublin* and *Belfast*, Ginger Ale, Sparkling Montserrat, Potash, Soda, and Seltzer Waters, and Lemonade.
CHLOROZONE FLUIDS COMPANY, THE, *London*, Chlorozone and Eureka Fluids.
CLARK E., & Co., *London*, Coffee Extract.
DOULTON & Co., *London*, Manganous Carbon Filters.
DUBLIN & WICKLOW MANURE Co., *Dublin*, Strype's Process for Drying Blood.
GLEN MILLS COMPANY, THE, *Dublin*, Self-Raising Flour.
HOLOHAN & SONS, *Dublin*, Lemonade, Soda Water, Seltzer Water Aromatic Ginger Ale.
HOTBLACK, J. & SONS, *Norwich*, the Health Boot.
LANE, DENNY, *Cork*, Silverspring Rice Starch.
McDOUGALL & GUNN, *Glasgow*, Lavage Boon and Soaps.
RIMMEL, E., *London*, Transparent Coal Tar Soap.
ROSS & Co., *Belfast*, Ginger Ale, Soda, Potash, and Seltzer Waters, and Lemonade.
SCOTT, A. & R., *Glasgow* and *London*, Midlothian Oat Flour.
SHANKS & Co., *Dublin*, Soda and Seltzer Waters, Aromatic Ginger Ale, and Lemonade.

We mentioned in our Report last year, that the Committee specially appointed by the Institute to carry out experiments on cowls had found that the indications of the ordinary air meters which are used for testing cowls are unreliable.

The Committee have succeeded in determining accurately the values of the indications given by certain air meters, and are now actively engaged in carrying out a series of experiments on various cowls with these corrected meters.

Until the Report of this Committee appears, we are unable to give any awards for cowls and this class of ventilators.

No award can be made of the Richardson Gold Medal until the deferred trials have taken place.

(*Signed*) W. H. CORFIELD, M.A., M.D.Oxon., *Chairman*.
H. C. BARTLETT, Ph.D., F.C.S.
F. S. B. F. DE CHAUMONT, M.D., F.R.S.
ROGERS FIELD, B.A., M.Inst.C.E.
J. WALLACE PEGGS, Assoc.M.Inst.C.E.
H. SAXON SNELL, F.R.I.B.A.
ERNEST TURNER, F.R.I.B.A.

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SUPPLEMENTARY REPORT OF THE JUDGES ON THE EXHIBITS DEFERRED FOR FURTHER PRACTICAL TRIAL.

DUBLIN, 1884.

Out of the thirty-nine Exhibits deferred for further practical trial, as mentioned in the Report, the following were submitted by the exhibitors :—

DOCKRELL, THOMAS, SONS & Co., *Dublin*, Cheap Artistic Non-poisonous and Washable Wall Papers.

*GANDY, MAURICE, *London*, Cotton Machine Belting.

BOURTREEHILL COAL Co., *Dreghorn*, *Ayrshire*, *N.B.*, White Enamelled Fireclay Laundry Trough.

MAGUIRE & SON, *Dublin*, Wilcocks' Automatic Flushing Closet.

WENHAM'S PATENT GAS LAMP COMPANY, *London*, Regenerative Gas Burner.

BENSDORP & Co., *London*, Soluble Dutch Cocoa.

BURROUGHS, WELLCOME & Co., *London*, Kepler's Extract of Malt, and ditto with combinations.

CLARK, E. & Co., *London*, Coffee Extract.

*DOULTON & Co., *London*, Manganous Carbon Filters.

DUBLIN & WICKLOW MANURE Co., *Dublin*, Strype's Process for Drying Blood.

LANE, DENNY, *Cork*, Silverspring Rice Starch.

We recommend that Medals be awarded to the undermentioned exhibitors :—

DUBLIN & WICKLOW MANURE Co., *Dublin*, for Strype's Process for Drying Blood.

WENHAM'S PATENT GAS LAMP Co., *London*, for Wenham's Ventilating Gas Lamp.

We also recommend that Certificates of Merit be awarded to the undermentioned exhibitors :—

DOCKRELL, THOMAS, SONS & Co., *Dublin*, for Cheap Artistic Non-arsenical Washable Wall Papers.

BOURTREEHILL COAL Co., *Dreghorn*, *Ayrshire*, for White Enamelled Fireclay Laundry Trough.

* See note at end of Report on next page.

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MAGUIRE & SON,, *Dublin*, for Wilcocks' Automatic Flushing Closet.
BENSDORP & Co., *London*, for Soluble Dutch Cocoa.
BURROUGHS, WELLCOME & Co., *London*, for Kepler's Extract of Malt, and combinations of it with Pepsine, Chocolate, and Cod Liver Oil.
CLARK, E. & Co., *London*, for Coffee Extract.
MAIGNEN, P. A., *London*, for Anti-Calcaire Powders for Softening Water, exhibited at the Glasgow Exhibition, 1883.

We have much pleasure in recommending that the Richardson Medal be awarded to—

EDMUNDSON, J. & Co., *Dublin*, for exhibit of Swann's Electric Lamps.

* We have not yet had sufficient opportunity of testing the exhibits marked with an asterisk, and they are therefore of necessity deferred for a future Report.

W. H. CORFIELD, M.A., M.D.Oxon., *Chairman*.
H. C. BARTLETT. Ph.D., F.C.S.
F. S. B. F. DE CHAUMONT, M.D., F.R.S.
W. EASSIE, C.E.
ROGERS FIELD, B.A., M.Inst.C.E.
HENRY LAW, M.Inst.C.E.
J. WALLACE PEGGS, A.M.Inst.C.E.
H. SAXON SNELL, F.R.I.B.A.
ERNEST TURNER, F.R.I.B.A.

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CONFERENCE ON DOMESTIC SANITATION,

HELD AT

THE INTERNATIONAL HEALTH EXHIBITION,

JUNE 9 TO 14TH, 1884.

AT the request of the Executive Council of the International Health Exhibition, the Sanitary Institute of Great Britain, the Society of Medical Officers of Health, and the Parkes Museum of Hygiene, combined together for the purpose of organizing a Conference on Sanitary Subjects, and to this end each Society appointed three of its leading members to represent it on a joint Committee.

The joint Committee was thus constituted:—Dr. Alfred Carpenter, J.P., Chairman of Council of the Sanitary Institute; Professor W. H. Corfield, M.A., M.D., Medical Officer of Health for St. George's, Hanover Square; Mr. Ernest Turner, F.R.I.B.A., representing the Sanitary Institute. Dr. T. Orme Dudfield, President of the Society of Medical Officers of Health, Medical Officer of Health for Kensington; Dr. J. S. Bristowe, F.R.S., Medical Officer of Health for Camberwell; Mr. A. Wynter Blyth, M.R.C.S., Medical Officer of Health for St. Marylebone, representing the Society of Medical Officers of Health. Captain Douglas Galton, R.E., C.B., F.R.S., Chairman of Council Parkes Museum; Rogers Field, B.A., M.INST.C.E.; Dr. Louis Parkes representing the Parkes Museum of Hygiene.

Dr. Dudfield was elected Chairman of this Committee, and Dr. Louis Parkes was appointed Honorary Secretary.

The work of organizing the Conference was satisfactorily carried through, the aim of the joint Committee being to bring forward at the Conference by means of Papers, whose authors should be men distinguished in Sanitary work, matters bearing on Public Health, which should not only throw light and provide instruction on some of the great sanitary problems of the day, but which should be capable of discussion, so that a general agreement of Sanitarians on

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disputed points might be obtained, and public opinion be thereby guided into the right channels.

The Conferences were very numerously attended, and the subjects of the Papers read were subsequently discussed by some of the most distinguished Sanitarians in the country, including Members of Parliament, Engineers, Architects, Physicians, and Medical Officers of Health. In addition, on Friday, the Conference was honoured by the presidency of the Right Hon. Earl Fortescue; on Saturday, by the presidency of Sir J. McGarel Hogg, Bart., M.P., Chairman of the Metropolitan Board of Works; and on Wednesday, by the presidency of Mr. Edwin Chadwick, C.B.

On Thursday the Conference was honoured by the presence of His Grace the Duke of Buckingham and Chandos, G.C.S.I., Chairman of the Executive Council of the International Health Exhibition, who addressed the meeting.

The Conference lasted from Monday, 9th, to Saturday, 14th June.

Monday, June 9th, Dr. T. Orme Dudfield, President of the Society of Medical Officers of Health, took the chair. Dr. J. W. Tripe, Medical Officer of Health for Hackney, read a paper on "The Domestic Sanitary Arrangements of the Metropolitan Poor."

Mr. Ernest Turner, F.R.I.B.A., read a paper on the "Improvement of the Sanitary Arrangements of Metropolitan Houses."

Tuesday, June 10th, Captain Douglas Galton, C.B., F.R.S., Chairman of Council Parkes Museum of Hygiene, took the chair. Dr. George Wilson, Medical Officer of Health for Mid-Warwickshire, read a paper on "Domestic Sanitation in Rural Districts." Mr. H. Percy Boulnois, M.INST.C.E., Borough Engineer, Portsmouth, read a paper on "Sanitary Houses for the Working Classes in Urban Districts."

Wednesday, June 11th, His Grace The Duke of Northumberland being prevented from presiding owing to sudden illness, Dr. Alfred Carpenter took the chair, which he subsequently vacated to Mr. Edwin Chadwick. Dr. J. Syer Bristowe, F.R.S., Medical Officer of Health for Camberwell, read a paper on "Industrial Diseases."

Thursday, June 12th, Dr. Alfred Carpenter, J.P., Chairman of Council Sanitary Institute, took the chair. Professor W. H. Corfield, M.A., M.D., F.R.C.P., Medical Officer of Health for St. George's,

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Hanover Square, read a paper on "How Infectious Diseases are Spread." Dr. R. N. Thursfield, Medical Officer of Health, Shropshire Combined San. Dist., read a paper on "Cows' Milk as a Vehicle of Infectious and Epidemic Diseases to the Community, with suggestions for the more effectual Prevention of such Outbreaks." Friday, June 13th, Right Hon. Earl Fortescue took the chair and addressed the meeting. Dr. Alfred Hill, Medical Officer of Health for Birmingham, then read a paper on "The Notification of Infectious Diseases, its Importance and its Difficulties." Dr. Alfred Carpenter read a paper on "The Right of the State to Enforce Notification, and the best method of doing it." Saturday, June 14th, Sir James M'Garel Hogg, Bart., M.P., took the chair. Mr. Wynter Blyth, Medical Officer of Health for Marylebone, read a paper on "Disposal of the Dead." Mr. W. Eassie, C.E., F.G.S., read a paper on "Cremation."

All the papers, with the discussions which followed, are published *in extenso* in volume viii. of the "Health Exhibition Literature."

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APPENDIX.

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EXAMINATIONS IN SANITARY SCIENCE FOR LOCAL SURVEYORS AND INSPECTORS OF NUISANCES.

BOARD OF EXAMINERS.

Chairman.

CAPT. DOUGLAS GALTON, R.E., C.B., D.C.L., F.R.S.

H. C. BARTLETT, PH.D., F.C.S.
A. WYNTER BLYTH, M.R.C.S.
PROF. W. H. CORFIELD, M.A. LOND., M.D. OXON.
PROF. F. S. B. F. DE CHAUMONT, M.D., F.R.S.
ROGERS FIELD, B.A., M.INST. C.E.
R. B. GRANTHAM, M.INST.C.E.
PROF. T. HAYTER LEWIS, F.S.A., F.R.I.B.A.
W. H. MICHAEL, Q.C., F.C.S.
PROF. H. ROBINSON, M.INST. C.E.
M. OGLE TARBOTTON, M.INST. C.E., F.G.S.
ERNEST TURNER, F.R.I.B.A.

Registrar.

G. J. SYMONS, F.R.S.

THE great and increasing importance of the duties devolving upon Local Surveyors and Inspectors of Nuisances in connection with the various Acts relating to Public Health, the Sale of Food and Drugs Act, &c., has led the Council of the Sanitary Institute of Great Britain to establish Voluntary Examinations, to appoint a Board of Examiners, and to grant Certificates of Competency to Local Surveyors and Inspectors of Nuisances.

Visitors duly appointed by the Local Government Board and various bodies connected with the practical application of sanitary science are invited to be present at the Examinations.

The Examinations, which are arranged in two grades, are intended to enable Local Surveyors and Inspectors of Nuisances, or persons desirous of becoming such, or of obtaining the Certificate of the Institute, to prove their competency in the subjects of Examination. Successful Candidates will be placed on the Register of persons so certificated; this Register will be kept at the Offices of the Institute, and a copy will be forwarded to Local Boards and Sanitary Authorities on application.

Each Examination occupies a portion of two days. On the first day the Examination of Surveyors occupies four hours—viz., from 12 noon till 2 p.m., and from 4 p.m. till 6 p.m., and consists of written papers only. Inspectors of Nuisances have two hours' written examination on the first day—viz., from 2 p.m. till 4 p.m. On the second day the Examination, for both classes, commences at 11 a.m., and is

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vivâ voce, with one or more questions to be answered in writing, *if deemed necessary*. A Certificate of competency, signed by the examiners, is granted to successful Candidates, entitling them to be designated as "Certificated by the Sanitary Institute of Great Britain."

As one person may, under the Public Health Act, 1875, be both Local Surveyor and Inspector of Nuisances, the Examinations are so arranged that Candidates who desire to do so, can enter for both Examinations on the same occasion.

Candidates are required to furnish the Board of Examiners with satisfactory testimonials as to personal character, and to give two weeks' notice to the Registrar previous to presenting themselves for Examination, stating whether they wish to be examined as Surveyors, as Inspectors of Nuisances, or as both. The fee for Examination must be paid to the Secretary, by Post-Office order or otherwise, at least six days before the day of Examination. On the receipt of the fee, a ticket will be forwarded admitting to the Examination.

The fees payable for the Examinations are as follows:—

For Surveyors	£5 5s.
For Inspectors of Nuisances . .	£2 2s.

Unsuccessful Candidates are allowed to present themselves a second time for one fee.

Examinations are appointed to be held at the Rooms of the Institute:—

On Thursday and Friday, November 12th and 13th, 1885.
On Thursday and Friday, June 3rd and 4th, 1886.

Forms to be filled up by Candidates previous to Examination will be supplied on application to the Secretary, 74A, Margaret Street, W

SYLLABUS of SUBJECTS for EXAMINATION.

FOR LOCAL SURVEYORS.

LAWS AND BYE-LAWS—A thorough knowledge of the Acts affecting Sanitary Authorities, as far as they relate to the duties of Local Surveyors; also, of the Model Bye-Laws issued by the Local Government Board.

SEWERAGE AND DRAINAGE—The Sanitary principles which should be observed in the preparation of schemes for, and the construction of, Sewerage works; the ventilation and flushing of sewers and drains; the internal drainage and other Sanitary areangements of houses, privies, water-closets, dry-closets, and the removal of refuse; the Sanitary details of Builders' and Plumbers' work.

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WATER SUPPLY OF TOWNS AND HOUSES—The Sanitary principles which should be observed in the preparation of schemes for, and the construction of, Water-works; the various ways in which water is likely to become polluted, and the best means of ensuring its purity.

REGULATION OF CELLAR DWELLINGS AND LODGING HOUSES—General principles of Ventilation; the amount of air and space necessary for men and animals; the means of supplying air, and of ensuring its purity.

HIGHWAYS AND STREETS—The Sanitary principles which should be observed in the construction and cleansing of streets and roads.

All persons who have passed the above Examination and received the Certificate for Local Surveyors are, by virtue of having so passed, entitled to become Members of the Institute for Life, upon payment of Five Guineas (without Annual Subscription), in addition to the fee paid for the Examination.

FOR INSPECTORS OF NUISANCES.

A thorough knowledge of the Provisions of the Acts and Model Bye-Laws relating to the duties of Inspector of Nuisances—also of the working of the Sale of Food and Drugs Act.

A fair knowledge of the principles of Ventilation, and the simple methods of Ventilating Rooms—Measurement of Cubic Space.

A knowledge of the Physical Characteristics of Good Drinking Water—the various ways in which it may be polluted, and the means of preventing pollution—Methods of Water Supply.

A knowledge of the proper conditions of good drainage.

The advantages and disadvantages of various Sanitary Appliances for Houses—Inspection of Builders' and Plumbers' work.

A knowledge of what constitutes a Nuisance, arising from any Trade, Business, or Manufacture.

A fair knowledge of the characteristics of good and bad Food (such as Meat, Fish, Milk, Vegetables), so as to be able to recognise unsoundness.

Some knowledge of Infectious Diseases, and of the Regulations affecting persons suffering or recovering from such diseases.

A knowledge of the best Methods of Disinfection.

Methods of Inspection, not only for Dwellings, Cellar Dwellings, Dairies, and Milk-Shops, but of Markets, Slaughter-Houses, Cow-Sheds, and offensive Trades.

Scavenging and the Disposal of Refuse.

All persons who have passed the above Examination and received the Certificate for Inspectors of Nuisances are, by virtue of having so passed, entitled to become Associates of the Institute for Life, upon payment of Three Guineas (without Annual Subscription), in addition to the fee paid for the Examination.

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LIST OF BOOKS SUGGESTED BY THE EXAMINERS AS USEFUL TO CANDIDATES.

SURVEYORS.

Laws and Bye-Laws.

The principal Acts affecting Sanitary Authorities, viz:—

Gas Works Clauses Acts, 1847. *Price* 6*d.*
Water Works „ „ 1847. *Price* 1*s.*; & 1863, *price* 3*d.*
Public Health Act, 1875. *Price* 5*s.* 7½*d.*
„ „ Water, 1878. *Price* 4½*d.*
Rivers Pollution Act, 1876. *Price* 6*d.*
Artizans' and Labourers' Dwellings Acts, 1868. *Price* 7½*d.*; and 1875, *price* 1*s.*
} *Sold by Eyre & Spottiswoode.*

Local Government Board. Model Bye-Laws for Sanitary Authorities. *Eyre & Spottiswoode. Price* 4*s.* 6*d.*

†Chambers, George F. Digest of the Law relating to Public Health and Local Government. 7th Edition. *Stevens & Son. Price* £1 8*s.*

†Fitzgerald, Vesey. Public Health Act and Local Government Act, 1875. 3rd Edition. *Waterlow Bros. & Layton. Price* 12*s.* 6*d.*

†Glen, W.C., Q.C. Public Health Act. *Knight. Price* £1 16*s.*

†Lumley. Public Health Act, 1875. *Shaw & Son. Price* £1 5*s.*

†Michael & Will. On Gas and Water. *Butterworth. Price* £1 5*s.*

Stratton's Public Health Acts, 1875. 1880 Edition. *Knight. Price* 3*s.* 6*d.*

†Woolrych. On the Metropolis Local Management Acts. 2nd Edition. *Shaw & Son. Price* £1 1*s.*

†Smith, William Robert, M.D., and Smith, Henry, M.B. The Laws Concerning Public Health. *Sampson Low & Co. Price* £1 11*s.* 6*d.*

Sewerage and Drainage.

Boulnois, H. P., M.Inst.C.E. The Municipal and Sanitary Engineer's Hand-Book. *E. & F. N. Spon. Price* 12*s.* 6*d.*

Buchan, W. Paton. Plumbing. *Crosby, Lockwood & Co. Price* 3*s.* 6*d.*

Denton, J. Bailey, M.Inst.C.E. Sanitary Engineering. *E. & F. N. Spon. Price* £1 5*s.*

Field, Rogers, M.Inst.C.E. Bye-Laws and Regulations with reference to House Drainage. *E. & F. N. Spon. Price* 1*s.*

Fox, Cornelius B., M.D. Disposal of the Slop Water of Villages. *J. & A. Churchill. Price* 1*s.* 6*d.*

Galton, Douglas, C.B., F.R.S. Observations on the Construction of Healthy Dwellings. *Henry Frowde. Price* 10*s.* 6*d.*

Hellyer, S. S. The Plumber, and Sanitary Houses. 2nd Edition. *B. S. Batsford. Price* 10*s.* 6*d.*

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KNIGHT & Co. Annotated Model Bye-Laws of the Local Government Board relating to—I. Cleansing of Privies, &c. II. Nuisances. III. New Buildings. *Knight & Co. Price* 8s. 6d.

LATHAM, BALDWIN, M.INST.C.E. Sanitary Engineering. *E. & F. N. Spon. Price* £1 10*s.*

RAWLINSON, ROBT., C.B. Suggestions as to Drainage, Sewerage, and Water Supply. *Knight. Price* 3*s.*

†Report of the Committee of The Local Government Board on Treatment of Town Sewage. *Hansard & Co. Price, Report* 1*s.*; *Plans* 10*s.*

RUSSELL, J. A. Two Lectures to Builders and Plumbers. *Simpkin, Marshall & Co.*, 1878. *Price* 1*s.* 6*d.*

ROBINSON, HENRY, C.E., F.G.S. Sewage Disposal. *E. & F. N. Spon. Price* 5*s.*

WATER SUPPLY OF TOWNS AND HOUSES.

†BUCHAN, A. Introductory Text Book of Meteorology. 2nd Edition. *W. Blackwood & Sons. Price* 4*s.* 6*d.*

†HUMBER, WILLIAM, ASSOC.M.INST.C.E. Water Supply of Cities and Towns. *Crosby, Lockwood & Co. Price* £6. 6*s.*

PARRY, JOSEPH, C.E. Water: its Composition, Collection, and Distribution. *F. Warne. Price* 2*s.* 6*d.*

†Sixth Report of the Royal Commissioners on Pollution of Rivers. *Hansard & Co. Price* 16*s.*

REGULATION OF CELLAR DWELLINGS AND LODGING HOUSES, VENTILATION, &C.

GALTON, DOUGLAS, C.B., F.R.S. Observations on the Construction of Healthy Dwellings. *Henry Frowde. Price* 10*s.* 6*d.*

HARTLEY, W. NOEL. Air and its Relation to Life. *Longmans, Green & Co. Price* 6*s.*

†PARKES, E. A., M.D., F.R.S., and F. DE CHAUMONT, M.D., F.R.S. A Manual of Practical Hygiene (Chapters on Air). *J. & A. Churchill. Price* 18*s.*

HIGHWAYS AND STREETS.

BOULNOIS, H. P., M.INST.C.E. The Municipal and Sanitary Engineer's Hand-Book. *E. & F. N. Spon. Price* 12*s.* 6*d.*

CODRINGTON, T., M.INST.C.E. Maintenance of Macadamised Roads. *E. & F. N. Spon. Price* 6*s.*

GENERAL.

†PARKES, E. A., M.D., F.R.S., and F. DE CHAUMONT, M.D., F.R.S. A Manual of Practical Hygiene. *J. & A. Churchill. Price* 18*s.*

†WILSON, G., M.A., M.D. Handbook of Hygiene and Sanitary Science. *J. & A. Churchill. Price* 10*s.* 6*d.*

†MURPHY, SHIRLEY F. Our Homes, and how to make them Healthy, *Cassell & Co. Price* 15*s.*

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INSPECTORS OF NUISANCES.

The Principal Acts relating to the Duties of Inspectors, viz:—

Public Health Act, 1875. *Price* 5*s.* 7½*d.*
" " Water, 1878. *Price* 4½*d.*
Canal Boats Act, 1877. *Price* 3*d.*
Sale of Food and Drugs Acts, 1875. *Price* 6*d.*; and 1879, *price* 3*d.*
Rivers Pollution Act, 1876. *Price* 6*d.*
Artizans' and Labourers' Dwellings Acts, 1868. *Price* 7½*d.*; and 1875, *price* 1*s.*
Alkali, &c., Works Regulations Act, 1881. *Price* 5*d.*
Nuisances Removal Acts, 1855. *Price* 1*s.*; 1860, *price* 3*d.*; and 1866, *price* 1½*d.*

Sold by Eyre & Spottiswoode.

Local Government Board. Model Bye-Laws for Sanitary Authorities. *Eyre & Spottiswoode. Price* 4*s.* 6*d*

Local Government Board. General Orders relating to Duties of Inspectors of Nuisances, issued March 10th and 13th, 1880.

Metropolitan Board of Works. Bye-Laws under the Slaughter-houses, &c., Act; eight in number.

Metropolitan Board of Works. The Dairies Cowsheds, and Milkshops Order of July, 1879.

STRATTON's Public Health Acts, 1875. 1880 Edition. *Knight. Price* 3*s.* 6*d.*

†WOOLRYCH. On the Metropolis Local Management Acts. 2nd Edition. *Shaw & Son. Price* £1. 1*s.*

CORFIELD, W. H., M.A., M.D. The Laws of Health. *Longman & Co. Price* 1*s.* 6*d.*

CORFIELD, W. H., M.A., M.D. Dwelling Houses: their Sanitary Construction and Arrangements. *H. K. Lewis. Price* 3*s.* 6*d.*

F. DE CHAUMONT, M.D., F.R.S. Manuals of Health. The Habitation in Relation to Health. *Society for Promoting Christian Knowledge. Price* 1*s.*

FIELD, ROGERS, M.INST.C.E. Bye-Laws and Regulations with Reference to House Drainage. *E. & F. N. Spon. Price* 1*s.*

KNIGHT & CO. Annotated Model Bye-Laws of the Local Government Board relating to—I. Cleansing of Privies, &c. II. Nuisances. III. New Buildings. *Knight & Co. Price* 8s. 6d.

HARTLEY, W. NOEL. Water, Air, and Disinfectants. *Society for Promoting Christian Knowledge. Price* 1*s.*

†PARKES, E. A., M.D., F.R.S., and F. DE CHAUMONT, M.D., F.R.S. A Manual of Practical Hygiene. (Chapters on Water, Air, Food, and Sewage). *J. & A. Churchill. Price* 18*s.*

†MURPHY, SHIRLEY F. Our Homes, and how to make them Healthy. *Cassell & Co. Price* 15*s.*

† *Books marked thus are Works of Reference.*

It is not necessary that Candidates should study all the works mentioned in this List, as two or three are quoted in some subjects to afford greater facilities for obtaining the information.

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EXAMINATIONS FOR LOCAL SURVEYORS AND INSPECTORS OF NUISANCES.

The following Candidates received Certificates during the year 1884.

LOCAL SURVEYORS.

1884, June 6, Gilby, C., Bath.
1884, Nov. 7, Phillipson Burton, R., Dublin.
1884, June 6, Radford, W. H., Nottingham.
1884, June 6, Tattersall, W., Accrington.
1884, Nov. 7, Thomson, Gilbert, Glasgow.
1884, June 6, Wilson, J. B., Arlecdon, Carnforth.
1884, Nov. 7, Worth, J. Edward, Burslem.

INSPECTORS OF NUISANCES.

1884, June 6, Ainge, T. Styles, Bristol.
1884, June 6, Beck, W. C., Hastings.
1884, Nov. 7, Brooks, J., Lees Brook, near Oldham.
1884, June 6, Cameron, Kenneth, Aberdeen.
1884, Nov. 7, Daly, W., Lees Road, Oldham.
1884, June 6, Easton, C. J., Gosport.
1884, Nov. 7, Fraser, W., Liverpool.
1884, June 6, Gibbs, R., Portsmouth.
1884, June 6, Haslam, T. Tonge, Bolton.
1884, Nov. 7, Houghton, J., Moseley, near Birmingham.
1884, June 6, Jeffery, R., Bedford Row.
1884, June 6, Joblings, G. W., Sunderland.
1884, Nov. 7, Keal, J., Sutton, Surrey.
1884, Nov. 7, Loach, J., Handsworth, Birmingham.
1884, June 6, Mallinson, J., Colne, Lancashire.
1884, Nov. 7, Marshall, J., Hornby, Lancaster.
1884, June 6, Parker, J., Birmingham.

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1884, Nov. 7, POTTER, BEN., Brixton.
1884, June 6, POULSON, F. T., Tottenham.
1884, Nov. 7, ROLLINSON, A. H., Chesterfield.
1884, June 6, SHADRAKE, W. A., Poplar.
1884, Nov. 7, SIMPSON, J. T., Hull.
1884, June 6, SUTCLIFFE, A., Thornton, near Bradford.
1884, June 6, TURNER, THOMAS, Bolton.
1884, Nov. 7, WHEAT, T., Sunderland.
1884, June 6, WHYTE, JAMES, Edinburgh.
1884, Nov. 7, WINSER, F. SAWYER, Charing Cross, S.W.

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EXHIBITIONS OF SANITARY APPARATUS AND APPLIANCES.

THE Exhibitions of Sanitary Appliances are held annually in connection with the Autumn Congress, and unpatented exhibits are protected by a certificate granted by the Board of Trade, under the Patents Designs and Trade Marks Act, 1883.

Judges are appointed by the Council to examine the several exhibits, and award Medals and Certificates of Merit to such objects as they may consider worthy.

In addition to the Ordinary Medals, a special Medal—the Richardson Medal—is offered by the Institute, for a selected exhibit from the entire exhibition, and will be awarded by the Judges in cases of pre-eminent merit only. Selected exhibits of such a nature as to require practical trials which cannot be carried out on the spot, are submitted to such trials upon the Exhibitors defraying the necessary expenses.

The Exhibits are arranged in the following Classes:—

CLASS I.—BUILDING MATERIALS, CONSTRUCTION AND MACHINERY.

- Materials and Construction.
- Damp-proof Courses.
- Paints and other Protectives.
- Wall Papers and Coverings.
- Flooring.
- Decorative Materials.
- Machinery adapted for Sanitary Purposes.
- Laundry Appliances.

CLASS II.—WATER SUPPLY AND SEWERAGE.

- Apparatus for Water Supply.
- Filtering and Softening Water.
- Water Waste Preventors.
- Flushing and Watering.
- Sinks.
- Baths and Lavatories.
- Water Closets.
- Urinals.
- Drain Pipes.
- Traps.
- Dry Closets.
- Sewage Treatment.
- Miscellaneous Sanitary Goods.

CLASS III.—HEATING, LIGHTING, AND VENTILATING.

- Heating Apparatus.
- Cooking Apparatus.
- Smoke Preventing Appliances.
- Lighting, including Electric Lighting.
- Ventilating Gas Burners.
- Ventilators.

CLASS IV.—PERSONAL HYGIENE, FOODS, FILTERS & DISINFECTANTS.

- Clothing.
- Beds and other Furniture.
- Hospital and Sick Room Appliances.
- Domestic Appliances.
- School Fittings.
- Gymnastic Apparatus.
- Foods.
- Domestic Filters
- Mineral Waters.
- Soaps and other Detergents.
- Antiseptics and Disinfectants.
- Disinfecting Apparatus.

CLASS V.—MISCELLANEOUS.

Articles of Sanitary interest not included in the above Classes, such as:—

- Scientific Instruments.
- Books and Periodicals.
- Models and Drawings.
- Prevention of Accidents.
- Respirators and Face Guards for Unhealthy Occupations.
- Fire-preventing Appliances.
- Methods for the Disposal of the Dead, &c., &c., &c.

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EXHIBITIONS HELD IN CONNECTION WITH THE CONGRESSES OF THE INSTITUTE.

	1877. Leamington.	1878. Stafford.	1879. Croydon.	1880. Exeter.	1882. Newcastle.	1883. Glasgow.	1884. Dublin.
Number of Exhibitors	117	116	189	106	110	126	134
Number of Exhibits	294	319	710	500	600	750	900
Space occupied (in square ft.)	.....	.....	.....	9,725	14,520	20,000	40,000
Number of days Exhibition was open	14	16	17	19	25	25	19
Total number of Visitors	.....	.....	.....	8,955	8,373	20,000	35,000
Number of Medals awarded	13	13	12	12	15	21	13*
Number of Special Certificates	None.	6	9	7	4	13	11
Number of Certificates	None.	21	38	40	72	57	78*
Number of Exhibits deferred for further trial	.....	7	52	30	37	44	39

* These numbers do not include any Medals or Certificates which may be awarded for Exhibits deferred for practical trial.

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CLASSIFIED LIST OF MEDALS AWARDED AT THE EXHIBITIONS.

RICHARDSON MEDAL.

Siemens's Regenerative Gas Burner. Mather & Armstrong, *Newcastle-upon-Tyne.* NEWCASTLE, 1882.

Griffiths' Patent White. Silicate Paint Company, *Cannon Street, E.C.* STAFFORD, 1878.

SILVER MEDAL.

Offered by the Exeter Gas Company.

Dr. Bond's Euthermic Ventilating Gas Stove. Sanitary & Economic Supply Association, *Gloucester.* EXETER, 1880.

Eureka Gas Cooking Stove Wright, J. & Co., *Birmingham.* DUBLIN, 1884.

MEDALS AND SPECIAL CERTIFICATES.

In cases where awards are made at subsequent Exhibitions for the same Exhibits, only the name of the town and date are given. Exhibits which have already received Medals at previous Exhibitions of the Institute are excluded from awards of Medals; but those Exhibits to which a second Medal would otherwise be awarded receive Special Certificates, and these are distinguished in the following list by asterisks placed against the name of the town at which the Exhibition was held.

CLASS I.—BUILDING MATERIALS, CONSTRUCTION AND MACHINERY.

(1). Materials and Construction.

Aluminium Crown Metal. Aluminium Crown Metal Co., *Glasgow.* GLASGOW, 1883.

Delta Metal. Alex. Dick, *London.* GLASGOW, 1883.

Silicate Cotton (Slag-wool). J. A. G. Ross, *Newcastle-upon-Tyne.* NEWCASTLE, 1882.

Scottish Asbestos. Scottish Asbestos Co., *Glasgow.* GLASGOW, 1883.

Damp-proof Concrete Pavement. W. B. Wilkinson & Co. *Newcastle-upon-Tyne.* NEWCASTLE, 1882.

Silica Glazed and Enamelled Fire Clay Bricks and Fäience. Willcocks & Co., *Burmantofts, Leeds.* CROYDON, 1879.

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(2). Damp Proof Courses.

No awards.

(3). Paints and other Protectives.

Griffiths' Patent White, and for their preparations of Silicate Paint, Enamel Paint, and Petrifying Liquid. Silicate Paint Company, *Cannon Street, E.C.* STAFFORD, 1878.

Leadless "Charlton White" Paint and Dryers. J. B. Orr & Co., *Charlton, London.* GLASGOW, 1883.

Arcanum Process of Silver Plating Steel. Jefferson Read, *Birmingham.* CROYDON, 1879.

(4). Wall Papers and Coverings.

Paper Hangings free from Arsenic. Woollams & Co., *High Street, Marylebone, London.* CROYDON, 1879. *NEWCASTLE, 1882. *GLASGOW, 1883.

(5). Flooring.

Economic Hollow Flooring. G. E. Pritchett, 20, *Spring Gardens, London, S.W.* STAFFORD, 1878. *CROYDON, 1879.

(6). Decorative Materials.

Colouring Patterns through the Substance of Wood. H. Chalk Webb, *Worcester.* EXETER, 1880.

Wedgwood Ornamental Tiles. W. B. Morrison, *Glasgow.* GLASGOW, 1883.

Art Pottery. Doulton & Co., *London.* DUBLIN, 1884.

(7.) Machinery adapted for Sanitary Purposes.

Improved Six-Ton Steam Road Roller. Aveling & Porter, *Rochester,* CROYDON, 1879.

Fryer's Destructor, Fryer's Carbonizer, and Firman's Dessicating and Rendering Apparatus. Manlove, Alliott, Fryer & Co., *Nottingham.* NEWCASTLE, 1882.

(8). Laundry Appliances.

Improved Washer, with table complete. J. Borwell, *Britannia Foundry, Burton-on-Trent.* LEAMINGTON, 1877.

New "Shuttle" Steam Power Washing Machine. T. Bradford & Co., *London and Manchester.* LEAMINGTON, 1877. *STAFFORD, 1878.

Washing Machines. Thomas Bradford & Co., *London and Manchester.* NEWCASTLE, 1882. *GLASGOW, 1883. *DUBLIN, 1884.

CLASS II.—WATER SUPPLY AND SEWERAGE.

(1). Apparatus for Water Supply.

Anti-percussion High Pressure Valves. Doulton & Co., *Lambeth, London.* CROYDON, 1879. *EXETER, 1880. *GLASGOW, 1883. *DUBLIN, 1884.

Anti-percussion Ball Valve. Doulton & Co., *London.* NEWCASTLE, 1882.

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Improvements in Well Sinking Apparatus. Le Grand & Sutcliffe, *Bunihll Row, E.C.* LEAMINGTON, 1877. *CROYDON, 1879.
Buck's Automatic Rain-water Separator. C. G. Roberts, *Haslemere Surrey.* NEWCASTLE, 1882. *GLASGOW, 1883.

(2). Filtering and Softening Water.

No awards.

(3). Water Waste Preventers.

Direct Acting Valveless Waste Preventer. A. T. Bean, 5, *Cannon Row, S.W.* EXETER, 1880. *NEWCASTLE, 1882.
Siphon-action Water Waste Preventers. Shanks & Co., *Barrhead, N.B.* DUBLIN, 1884.

(4). Flushing and Watering.

No awards.

(5). Sinks.

Enamelled Fireclay Sinks. Craig, J. & M., *Kilmarnock.* DUBLIN, 1884.

(6). Baths and Lavatories.

Hot-Air Bath. T. Galbraith, *Crawford Square, Londonderry.* LEAMINGTON, 1877.
Concrete Bath in one piece. W. H. Lascelles, *Bunhill Row, E.C.* CROYDON, 1879. *EXETER, 1880.
Porcelain Bath. Joseph Cliff & Sons, *Leeds.* GLASGOW, 1883.
Fire-Clay Enamelled Bath. John Hall & Co., *Stourbridge.* GLASGOW, 1883.
Flushing Rim Lavatory Basin and Apparatus. J. Tylor & Sons, *Newgate Street, E.C.* EXETER, 1880.

(7). Water Closets.

Excelsior Water Closet. D. T. Bostel, *Duke Street, Brighton.* LEAMINGTON, 1877. *STAFFORD, 1878.
Full-flush Valveless Closet. Hayward, Tyler & Co., *London.* NEWCASTLE, 1882.
Household Water Closet. O. D. Ward, *London.* NEWCASTLE, 1882.

(8). Urinals.

No awards.

(9). Drain Pipes.

Stanford's Joints for Stoneware Pipes. Doulton & Co., *Lambeth, London.* STAFFORD, 1878. *EXETER, 1880.
Stoneware Pipes with Stanford's Joint. J. Stewart, Sen., *Glasgow.* *GLASGOW, 1883.
Acme Sewer Pipes. H. Percy Boulnois, *Portsmouth.* GLASGOW, 1883.

(10). Traps.

Exhibit of Stoneware Disconnecting Traps. J. Stewart, Sen., *Glasgow.* GLASGOW, 1883.

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(11). Dry Closets.

Dry Earth Closets. British Sanitary Company, *Glasgow.*
NEWCASTLE, 1882. *GLASGOW, 1883. *DUBLIN, 1884.

Excreta Pail (oak) with Spring Lid. B. B. Haresceugh & Co., *Bentinck Street, Leeds.* LEAMINGTON, 1877. * STAFFORD, 1878.

Dry Earth or Ashes Closet. R. R. Heap, *Manchester.*
GLASGOW, 1883. *DUBLIN, 1884.

Dry Closet, suitable for Ashes or Disinfecting Powder. L. Moser, *Southampton.* EXETER, 1880.

Moule's Earth Closets. Moule's Patent Earth Closet Company, 5*a*, *Garrick Street, W.C.* STAFFORD, 1878. *CROYDON, 1879.

Moule's Earth Closet. Wippell Bros. & Row, 231 and 232, *High Street, Exeter.* *EXETER, 1880.

Dry Earth Closet. J. Parker, *Woodstock, Oxford.*
LEAMINGTON, 1877.

Portable Cinder Sifting Ash Closet, with Soil Pail. Sanitary Appliance Company, *Salford.* STAFFORD, 1878. *CROYDON, 1879.

(12). Sewage Treatment.

No awards.

(13). Miscellaneous Sanitary Goods.

Sanitary Appliances, Exhibit of. W. P. Buchan, *Glasgow.*
GLASGOW, 1883.

Sanitary and Domestic Appliances, Exhibit of. Maguire & Son, *Dublin.* DUBLIN, 1884.

(14). Cisterns.

CLASS III.—HEATING, LIGHTING, AND VENTILATING.

(1). Heating Apparatus.

Ventilating Tile Stove. Doulton & Co., *Lambeth, London.*
EXETER, 1880. *NEWCASTLE, 1882. *GLASGOW, 1883.
*DUBLIN, 1884.

Challenge Hot-water Boiler. J. Keith, *London and Edinburgh.*
GLASGOW, 1883.

Slow Combustion Stoves. Musgrave & Co., *Belfast.* DUBLIN, 1884.

Dr. Bond's Euthermic Gas Stove. Sanitary & Economic Supply Association, *Gloucester.* EXETER, 1880.

(2). Cooking Apparatus.

Apparatus for Cooking by Gas. Billing & Co., *Hatton Garden, E.C.*
STAFFORD, 1878. *CROYDON, 1879.

Economical Cooking Range. G. H. Harris, *Bristol Street, Birmingham.* LEAMINGTON, 1877. *STAFFORD, 1878.

Phœnix Portable Range, and the Birmingham Range with Reducible Fire without Gas. Hassall & Singleton, *Birmingham.*
STAFFORD, 1878.

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Apparatus for Cooking by Gas. S. Leoni & Co., *Strand.* STAFFORD, 1878.

"Sine quâ non" Open and Close Fire Range. A. Shaw & Son, *Glasgow.* GLASGOW, 1883.

Artizan Cooking Range. Walker, Turnbull & Co., *Falkirk.* GLASGOW, 1883.

Improved Open or Close Range Kitchener. W. P. Wenham, *Church Street, Croydon.* CROYDON, 1879.

Wilson Portable Close Cooking Range. Wilson Engineering Company, *Holborn, W.C.* EXETER, 1880.

Improved Wilson Range with Steel Boiler and non-conducting Jacketing. Wilson Engineering Company, *London.* NEWCASTLE, 1882. *GLASGOW, 1883. *DUBLIN, 1884.

Eureka Gas Cooking Stove. Wright, J. & Co., *Birmingham.* DUBLIN, 1884.

Cooking Range with Revolving Fire for the Prevention of Smoke. Whyte & Bradford, *Bowness.* GLASGOW, 1883.

(3). Smoke Preventing Appliances.

Mechanical Stoker. G. Sinclair, *Leith.* GLASGOW, 1883.

(4). Lighting, including Electric Lighting.

Swan's Incandescent Electric Lights. Edmundson, J. & Co., *Dublin.* DUBLIN, 1884.

Prismoidal Pavement and Floor Lights. Hamilton & Co., *Leadenhall Street, E.C.* CROYDON, 1879.

Siemens's Regenerative Gas Burner. Mather & Armstrong, *Newcastle-upon-Tyne.* NEWCASTLE, 1882.

Mercury Gas Governor. James Stott & Co., *Oldham.* NEWCASTLE, 1882.

"Stott" Gas Governor. A. Brown & Co., *Glasgow.* *GLASGOW, 1883.

Stott's Mercury Gas Governor. Smallman, John L., *Dublin.* *DUBLIN, 1884.

(5). Ventilating Gas Burners.

No awards.

(6). Ventilators.

Conical Ventilators. J. E. Ellison, *Leeds.* STAFFORD, 1878. *CROYDON, 1879. *GLASGOW, 1883. *DUBLIN, 1884.

Auto-Pneumatic Ventilation. Nathan Hunt, *Bristol.* EXETER, 1880.

Glass Louvre Ventilators. J. Moore, *St. James' Walk, Clerkenwell. E.C.* EXETER, 1880.

CLASS IV. — PERSONAL HYGIENE, FOODS, FILTERS AND DISINFECTANTS.

(1). Clothing.

Innocuously-dyed Woollen Goods. Donegal Industrial Fund. DUBLIN, 1884.

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(2). Beds and other Furniture.

Excelsior Spring Mattress. Chorlton & Dugdale, *Manchester.* LEAMINGTON, 1877. *STAFFORD 1878. *CROYDON, 1879. *EXETER, 1880. *NEWCASTLE, 1882. *GLASGOW, 1883. *DUBLIN, 1884.

"Swing" Woven Wire Mattress. Chorlton & Dugdale, *Manchester.* DUBLIN, 1884.

"Universal" Invalid Tubular Water and Air Bed. Pocock Bros., *Southwark Bridge Road.* STAFFORD, 1878. *CROYDON, 1879.

Furniture, Exhibit of. Pim Bros., *Dublin.* DUBLIN, 1884.

(3). Hospital and Sick Room Appliances.

Invalid Furniture. J. Carter, 6*a*, *Cavendish Street, W.* EXETER, 1880.

Hospital and Sick Room Appliances, Exhibit of. W. B. Hilliard & Sons, *Glasgow.* GLASGOW, 1883.

Ambulance Wheeled Litter. Maj. F. Duncan, *The Common, Woolwich.* STAFFORD, 1878.

(4). Domestic Appliances.

Machine for Washing and Cooling Butter. F. & C. Hancock, *Dudley, Worcester.* LEAMINGTON, 1877. *STAFFORD, 1878.

Exhibit of Machines for Domestic use. F. & C. Hancock, *Dudley, Worcestershire.* GLASGOW, 1883.

Flat Webb Knitting Machine, and Rothwell Knitting Machines, Rothwell, W., *Bolton.* DUBLIN, 1884.

Friction Driving Attachment, for Sewing Machines. Singer Manufacturing Company, *London.* GLASGOW, 1883.

(5). School Fittings.

School Furniture. Colman & Glendenning, *Norwich.* EXETER, 1880.

(6). Gymnastic Apparatus.

No awards.

(7). Foods.

Powders for Peptonizing Milk. Burroughs, Wellcome & Co., *London.* DUBLIN, 1884.

(8). Domestic Filters.

Filtre Rapide. P. A. Maignen, *Great Tower Street, E.C.* CROYDON, 1879. *EXETER, 1880. *GLASGOW, 1883. *DUBLIN, 1884.

Bischof's Spongy Iron Filter. Spongy Iron Water Purifying Company, *Oxford Street, W.C.* LEAMINGTON 1877.

(9). Mineral Waters.

(10). Soaps and other Detergents.

No awards.

(11). Antiseptics and Disinfectants.

Calvert's Carbolic Acid for disinfecting purposes. Calvert & Co., *Bradford, Manchester.* LEAMINGTON, 1877. *CROYDON, 1879. *EXETER, 1880. *GLASGOW, 1883. *DUBLIN, 1884.

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Chemical Substances used for Disinfection. Mackey, Mackey & Co. *London.* DUBLIN, 1884.
Little's Soluble Phenyle. Morris, Little & Co., *Doncaster,* STAFFORD, 1878.
Sanitas Oil. Sanitas Company (Limited), *London.* NEWCASTLE, 1882.
Chemical Preparations and Apparatus. Société Française D'Hygiène, *Paris.* LEAMINGTON, 1877.

(12). Disinfecting Apparatus.

Portable Disinfecting Apparatus. Fraser Bros., *Commercial Road, E.* CROYDON, 1879.
Acid Pump and Syphon. Chas. W. Walker, *Wandsworth Common.* CROYDON, 1879.

CLASS V.—MISCELLANEOUS.

Articles of Sanitary Interest not included in the above Classes, such as :—

(1). Scientific Instruments.

No awards.

(2). Books and Periodicals.

Books on Hygiène. Société Francaise d'Hygiène, *Paris.* NEWCASTLE, 1882.
Sanitary Engineer of New York, Newspaper. H. C. Meyer, *New York.* GLASGOW, 1883.

(3). Models and Drawings.

No awards.

(4). Prevention of Accidents.

"Kredemnon" Life-saving Garments. F. Wentworth & Co., *London.* GLASGOW, 1883.

(5). Respirators and Face Guards for Unhealthy Occupations.

Tyndall's Smoke Respirator. J. Sinclair, *Leadenhall Street, E.C.* CROYDON, 1879.

(6). Fire Preventing Appliances.

(7). Methods for the Disposal of the Dead.

(8.) Sundries.

No awards.

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CERTIFICATES AWARDED AT THE EXHIBITIONS.

CLASS I.—BUILDING MATERIALS, CONSTRUCTION AND MACHINERY.

(1). Materials and Construction.

Adjustable Shoe and Regulating Spring Hinge for Swinging Doors. R. Adams, 7, *Great Dover Street, London, S.E.* CROYDON, 1879.
Fanlight Openers and Casement Fasteners. R. Adams, 7, *Great Dover Street, London, S.E.* CROYDON, 1879.
Norton Door Spring. R. Adams, *London.* DUBLIN, 1884.
Adjustable Pivot for Fanlights. R. Adams, *London.* DUBLIN, 1884.
White Enamelled Bricks. Bourtreehill Coal Co., *Dreghorn, Ayrshire.* DUBLIN, 1884.
Granite Vitrified Bricks and Paving. Candy & Co., *Newton Abbot.* EXETER, 1880.
Willesden Waterpoof Paper and Canvas. W. Carson & Sons, *Dublin.* DUBLIN. 1884.
Granite Concrete Pavement. T. Cordingley & Sons, *Bradford,* DUBLIN, 1884.
White Enamelled Bricks. J. & M. Craig, *Kilmarnock.* DUBLIN, 1884.
Silicon Tread For Steps. Doulton & Co., Lambeth, *London.* GLASGOW, 1883. DUBLIN, 1884.
Cotton Machine Belting. M. Gandy, *Liverpool.* GLASGOW, 1883.
Steil's Fastener for Machine Belting. M. Gandy, *Liverpool.* GLASGOW, 1883.
Opener for Fanlights and Skylights. W. & R. Leggott, *Bradford.* GLASGOW, 1883. DUBLIN, 1884.
Glazing without Putty. Pennycook Patent Glazing & Engineering Company, *Glasgow.* GLASGOW, 1883. DUBLIN, 1884.
Revolving Shutters, with Balance Weight Motion. Salmon, Barnes & Co., *Ulverston.* EXETER, 1880.
Hygeian Rock Building Composition. William White, *Abergavenny.* NEWCASTLE, 1882.
Chain Belting for Machinery. W. Wilby, *Dublin.* DUBLIN, 1884.

(2). Damp Proof Courses.

(3). Paints and other Protectives.

No awards.

(4). Wall Papers and Coverings.

"Lincrusta Walton." F. Walton & Co., *London.* GLASGOW, 1883.

(5). Flooring.

Parquet Flooring. A. Gardner & Son, *Glasgow.* GLASGOW, 1883.
Solid Oak Parquet Flooring. F. R. Scott & Co., *Dublin.* DUBLIN, 1884.

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(6). Decorative Materials.

Decorative Tiles for Covering Walls and Floors. Doulton & Co., *Lambeth, London.* CROYDON, 1879.

Marsden Tiling for Wall Decoration. Maguire & Son, *Dublin.* DUBLIN, 1884.

(7). Machinery adapted for Sanitary Purposes.

Improved Non-Absorbent Tub or Pail Van. J B. McCallum, *Stafford.* EXETER, 1880.

(8). Laundry Appliances.

"Vowel E." Bradford's Family Washing Machine. Garton & King, *Exeter.* EXETER, 1880.

Paragon Washing Machine with Canadian Washer. Kirsop & Co., *Newcastle-upon-Tyne.* NEWCASTLE, 1882.

Mitchell's Patent Steam Washer. James Mitchell, *Newcastle-upon-Tyne.* NEWCASTLE, 1882.

CLASS II.—WATER SUPPLY AND SEWERAGE.

(1). Apparatus for Water Supply.

Hydraulic Ram. W. Baird, *Dublin.* DUBLIN, 1884.

Latham's Flap Valve. Doulton & Co., *London.* NEWCASTLE, 1882.

Water-taps. J. Fell & Co., *Wolverhampton.* NEWCASTLE, 1882.

Large Way Waste Plug, with Protective Cover. Finch & Co., 181, *High Holborn, W.C.* CROYDON, 1879.

Hose Reel. Headley & Sons, *Cambridge.* CROYDON, 1879.

Improved Paragon Valve. W. Ross, *Glasgow.* GLASGOW, 1883.

Improved Full-Way Stop Valve. J. Tylor & Sons, 2, *Newgate Street, E.C.* EXETER, 1880.

Vacuum Flushing Cistern for Closet, with Seat-action Arrangement. Doulton & Co., Lambeth, *London.* DUBLIN, 1884.

Anti-percussion High-pressure Bib Valves. Doulton & Co., *London,* NEWCASTLE, 1882.

(2). Filtering and Softening Water.

No awards.

(3). Water Waste Preventers.

Waste-preventing Flushing Syphon. Henry Watson & Son, *Newcastle-upon-Tyne.* NEWCASTLE, 1882.

Syphon for Water Closet Cisterns. Braithwaite & Co., *Leeds.* CROYDON, 1879.

Bath Locking Valves, for preventing waste of water. Doulton & Co., *Lambeth, London.* NEWCASTLE, 1882.

"Waste Not" Regulator Valve. J. Tylor & Sons, 2, *Newgate Street, E.C.* EXETER, 1880. NEWCASTLE, 1882.

Bath Locking Valves for preventing Waste of Water. J. Tylor & Sons, *London.* NEWCASTLE, 1882.

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(4). Flushing and Watering.

Syphon Flushing Cistern. Wright & Stevens. NEWCASTLE, 1882.

(5). Sinks.

Butler's Sink, lined with Block Tin. W. Baird, *Dublin*. DUBLIN, 1884.

White Enamelled Fireclay Sinks. W. Baird, *Dublin*. DUBLIN, 1884.

White Enamelled Fireclay Sinks. Bourtreehill Coal Co., *Dreghorn, Ayrshire*. DUBLIN, 1884.

White Enamelled Fire Clay Sinks. J. & M. Craig, *Kilmarnock*. NEWCASTLE, 1882. GLASGOW, 1883.

Cheap Glazed Stoneware Sinks. Doulton & Co., Lambeth, *London*. DUBLIN, 1884.

"Artizans' Dwellings Sink." G. Jennings, *Stangate, London*. CROYDON, 1879.

White Enamelled Fireclay Sinks. Maguire & Son, *Dublin*. DUBLIN, 1884.

Swivel, Lock Plug, and Overflow for Sinks. Stidder & Co., 50, *Southwark Bridge Road, S E*. CROYDON, 1879.

Cup Grating for Sinks. Thomasson & Key, *Worcester*. NEWCASTLE, 1882.

Improved Enamelled Iron Slop Sink, with Regulator Supply Valve. J. Tylor & Sons, 2, *Newgate Street, London, E.C.* EXETER, 1880.

Hospital Slop Sink with Waste-not Regulator Valve. J. Tylor & Sons, *London*. NEWCASTLE, 1882.

Slop Sinks. T. Twyford, *Hanley*. DUBLIN, 1884.

Fire-Clay Sanitary Sinks, and Water Troughs. Willcock & Co., *Burmantofts, Leeds*. CROYDON, 1879.

(6). Baths and Lavatories.

Bath, with Shower Douche and Spray Fittings combined. W. Baird, *Dublin*. DUBLIN, 1884.

Lavatory, with Shampooing Apparatus. W. Baird, *Dublin*. DUBLIN, 1884.

Improved Horizontal-Pull Fittings to Baths and Lavatories. W. Baird, *Dublin*. DUBLIN, 1884.

Jennings's Universal Shampooing Apparatus. Dinning & Cooke, *Newcastle-upon-Tyne*. NEWCASTLE, 1882.

Locking Apparatus for Bath Fittings. Doulton & Co,, Lambeth, *London*. DUBLIN, 1884.

Tip-up Lavatory Basin. Doulton & Co., *London*. NEWCASTLE, 1882.

Clark's Anti-splash Tip-up Lavatory Basin. J. Fell & Co., *Wolverhampton*. NEWCASTLE, 1882.

Lavatory. Gillow & Co., *Oxford Street, W*. STAFFORD, 1878.

Shower and Douche Bracket. Hayward, Tyler & Co., *London*. NEWCASTLE, 1882.

"Universal" Shampooing Apparatus. G. Jennings, *Stangate, London*. CROYDON, 1879.

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Lavatory Basin with Flushing Rim. C. T. Maling, *Newcastle-upon-Tyne*, NEWCASTLE, 1882.
Enamelled Fire Clay Bath. Rimington Bros., & Co., *Newcastle-upon-Tyne*, NEWCASTLE, 1882.
Porcelain Baths, moulded and glazed in one piece. Ruffard & Co., *Clay Works, Stourbridge.* STAFFORD, 1878.
Cast Iron Bath. Shanks & Co., *Glasgow.* GLASGOW, 1883. DUBLIN, 1884.
Porcelain Lavatories, with moveable caps for access to fittings. Shanks & Co., *Glasgow.* GLASGOW, 1883. DUBLIN, 1884.
"Eureka" Spray and Plunge Bath. Shanks & Co.. *Glasgow.* GLASGOW, 1883.
Lavatory Basins. T. Twyford, *Hanley.* DUBLIN, 1884.
Flushing-rim Lavatory Basin with Quick Waste. J. Tylor & Sons, *London.* NEWCASTLE, 1882.

(7). Water Closets.

Artizan Closet. Beard, Dent & Hellyer, 21, *Newcastle Street, London, W.C.* CROYDON, 1879.
Economical Flush-Out Closet. Doulton & Co., *Lambeth, London.* EXETER, 1880. NEWCASTLE, 1882.
"Lambeth" Flush-out Closet. Doulton & Co., Lambeth, *London.* GLASGOW, 1883.
"Lambeth" Trough Closet with Automatic Flush Tank. Doulton & Co., Lambeth, *London.* GLASGOW, 1883.
Lambeth Combination Water Closet. Doulton & Co., *Lambeth, London.* DUBLIN, 1884.
Improved Seat for Water Closets. E. & A. E. Gilbert, *Broughty Ferry, Forfarshire.* GLASGOW, 1883.
Fowler's Water-closet. W. Harriman & Co., *Blaydon-upon-Tyne.* NEWCASTLE, 1882.
"National" Water Closet. W. B. Morrison, *Glasgow.* GLASGOW, 1883.
"Clear Way" Regulator Valve Water Closet, without overflow communicating with Valve Box. J. Tylor & Sons, 2, *Newgate Street, London, E.C.* EXETER, 1880.
Terry's Pedal-action for Water-closets. J. Tylor & Sons, *London.* NEWCASTLE, 1882.
"National" Water Closet. Henry Watson & Son, *Newcastle-upon-Tyne.* NEWCASTLE, 1882.
"Crown" Cottage Water Closet. Henry Watson & Son, *Newcastle-upon-Tyne.* NEWCASTLE, 1882.

(8). Urinals.

Flush-out Urinal Basin. J. Tylor & Sons, Newgate Street, *London.* NEWCASTLE, 1882.

(9). Drain Pipes.

Large Fire-clay Drain-pipes. Straker & Love, *Newcastle-upon-Tyne.* NEWCASTLE, 1882.

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Stoneware Pipes. Branksea Island Pottery Company (Limited), *Poole, Dorset.* EXETER, 1880.

Improved Drain-pipe with Access Cover. W. P. Buchan, *Glasgow.* NEWCASTLE, 1882.

Salt-glazed Fire-clay Sewer-pipes, Exhibit of. J. Binnie, *Gartcosh, Glasgow.* GLASGOW, 1883.

Stoneware Drain Pipes. Bourtreehill Coal Co., *Dreghorn, Ayrshire.* DUBLIN, 1884.

London-made Stoneware Pipes. Doulton & Co., Lambeth, *London.* DUBLIN, 1884.

Cast-iron Drain Pipes, coated with Angus Smith's Preparation. Maguire & Son, *Dublin.* DUBLIN, 1884.

Maguire's Cradle Joint for Drain-pipes. J. & M. Craig, *Kilmarnock.* NEWCASTLE, 1882.

Cast Iron Channels for Stable Drainage. Dinning & Cooke, *Newcastle-upon-Tyne.* NEWCASTLE, 1882.

Joint for Drain-pipes. Doulton & Co., *London.* NEWCASTLE, 1882.

Artificial Stone Tubes. Patent Victoria Stone Company, *Kingsland Road, London, E.* CROYDON, 1879.

Rock Concrete Tubes. Sharpe, Jones & Co., *Bourne Valley Pottery. Poole, Dorset.* CROYDON, 1879.

(10). Traps.

Ventilating Drain Syphon. Beard, Dent & Hellyer, 21, *Newcastle Street, W.C.* CROYDON, 1879.

Disconnecting Drain Trap. W. P. Buchan, *Glasgow.* NEWCASTLE, 1882. GLASGOW, 1883.

Grease Trap for Kitchen Sinks. W. P. Buchan, *Glasgow.* GLASGOW, 1883.

Buchan's Disconnecting Trap. J. & M. Craig, *Kilmarnock.* EXETER, 1880. DUBLIN, 1884.

Buchan's Disconnecting Drain Trap and Drain-pipes, with Access Cover. J. & M. Craig, *Kilmarnock.* NEWCASTLE, 1882.

Exhibit of Stoneware Disconnecting Traps. J. & M. Craig, *Kilmarnock.* GLASGOW, 1883.

Disconnecting Gully, with back and side Entrances and iron grating. Doulton & Co., *Lambeth, London.* CROYDON, 1879.

Reversible Inlet Gully, with Dished Stoneware Cover and Iron Grating. Doulton & Co., *London.* NEWCASTLE, 1882.

Dean's External Drain Traps, with moveable receptacle. J. C. Edwards, *Trefynant Ruabon.* CROYDON, 1879.

Smith's Cast Lead Syphon Traps. J. Fell & Co., *Wolverhampton.* NEWCASTLE, 1882.

Hornibrook's Catchment Grating for Steep Gradients. Hammond & Hussey, *High Street, Croydon.* CROYDON, 1879.

"Eagle" Sanitary Trap, for superseding Bell Traps. Hygienic Stove and Grate Company, 15, *Peel Buildings, Birmingham.* CROYDON, 1879.

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Edinburgh Air-Chambered Sewer Trap. Potts & Co., *Handsworth, Birmingham.* STAFFORD, 1878.

Dean's Gully Trap. Rimington Bros. & Co., *Newcastle-upon-Tyne.* NEWCASTLE, 1882.

Disconnecting Chamber for House Drains, with open Stoneware Channels. J. Stewart, Sen., *Glasgow.* GLASGOW, 1883.

Weaver's Ventilating Sewer Air Trap. James Stiff & Sons, *Lambeth, London.* STAFFORD, 1878.

(11). Dry Closets.

Self-Acting Earth Closet. British Sanitary Company, *Glasgow.* EXETER, 1880.

Moser's Self-Acting Dry Closet. J. C. Onions (Limited), *Birmingham.* CROYDON, 1879.

Dry Earth Commode without Separator. J. Parker, *Woodstock.* EXETER, 1880.

(12). Sewage Treatment.

Iron Basket Sewage-strainer. T. Harnett Harrisson, *Liverpool.* GLASGOW, 1883.

Pneumatic Liquid Ejector. Isaac Shone, *Wrexham.* STAFFORD, 1878.

(13). Miscellaneous Sanitary Goods.

Air-tight Man-hole Door. A. T. Angell, *London.* NEWCASTLE, 1882. GLASGOW, 1883.

Watts' Asphyxiator for Testing Drains with Smoke. Baird, Thompson & Co., *Glasgow.* DUBLIN, 1884.

Brian Jones's Joint for connecting Closet with Soil-pipe. Capper, Son, & Co., *London.* NEWCASTLE, 1882.

Enamelled Ware Open Channels for Manholes. Doulton & Co., Lambeth, *London.* DUBLIN, 1884.

Manhole for Drains, with connections complete. Doulton & Co., Lambeth, *London.* DUBLIN, 1884.

Improved method of connecting Lead Pipes with Stoneware Pipes. T. Harnett Harrisson, *Liverpool.* GLASGOW, 1883.

Sanitary Earthenware. C. T. Maling, *Newcastle-upon-Tyne.* NEWCASTLE, 1882.

Drain-cleaning Rods, and Stoneware Horse Manger. Oates & Green, *Horley Green Fire Clay Works, Halifax.* STAFFORD, 1878.

India-Rubber Connection for joining Lead and Earthenware Pipes. T. Twyford, *Hanley.* DUBLIN, 1884.

Joint for Lead Pipes. J. Tylor & Sons, 21, *Newgate Street, London.* NEWCASTLE, 1882.

CLASS III.—HEATING, LIGHTING AND VENTILATING.

(1). Heating Apparatus.

Gas Cooking Stove, lined with White Tiles. Arden Hill & Co., *Birmingham.* DUBLIN, 1884.

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Silicate Cotton Composition for Covering Steam Pipes. C. Cadle, *Dublin.* DUBLIN, 1884.

Tortoise Slow Combustion Stoves. W. Carson & Sons, *Dublin.* DUBLIN, 1884.

George's Calorigen. Dinning & Cooke, *Newcastle-upon-Tyne.* NEWCASTLE, 1882.

Grates, Mantel-pieces, and Over-mantels. Dinning & Cooke, *Newcastle-upon-Tyne.* NEWCASTLE, 1882.

Glazed Ware Mantelpiece, with Slow Combustion Grate. Doulton & Co., Lambeth, *London.* DUBLIN, 1884.

Tortoise Slow Combustion Stoves. Hydes & Wigfull, *Sheffield.* GLASGOW, 1883.

Tortoise Laundry Stove. Hydes & Wigfull, *Sheffield.* GLASGOW, 1883.

Laundry Stove and Copper Boiler. Maguire & Son, *Dublin* DUBLIN, 1884.

Steam Heating Apparatus, combining heating and ventilating. Mather & Armstrong, *Newcastle-upon-Tyne.* NEWCASTLE, 1882.

Warming and Ventilating Appliances. G. E. Pritchett, 20, *Spring Gardens, London, S.W.* STAFFORD, 1878.

Corrugated Iron Hot-Water Warming Appliances. G. E. Pritchett, 20, *Spring Gardens, S.W.* EXETER, 1880.

Thermhydric Ventilating Hot-water Open Fire Grate. H. Saxon Snell, *Southampton Buildings.* STAFFORD, 1878.

Tubular-Calorifer for Greenhouses. William Thornburn, *Borough Bridge.* NEWCASTLE, 1882.

Conservatory Boiler, with Hot-Water Pipe. Wippell Bros. & Row, *Exeter.* EXETER, 1880.

"Cosey" Portable Open Gas Fire, with Platinum Wire and Asbestos Packing. John Wright & Co., *Birmingham.* NEWCASTLE, 1882.

Ventilating Open Gas Fire. J. Wright & Co., *Birmingham.* DUBLIN, 1884.

(2). Cooking Apparatus.

Solid Flame Boiling Stove. Arden, Hill & Co., *Birmingham.* NEWCASTLE, 1882.

Combined Close Fire and Gas Cooking Range. Carron Co., *Falkirk.* GLASGOW, 1883.

"Sunlight Stove." Chorlton & Dugdale, 19, *Blackfriars Street, Manchester.* EXETER, 1880.

Devonshire Cooking Range. T. J. Constantine, *Fleet Street, E.C.* EXETER, 1880.

Tin Cooking Utensils. Mrs. A. Lewis, *Manchester.* CROYDON, 1879,

Dows' Close and Open Fire, Cooking Range. W. McGeoch & Co., *Glasgow.* GLASGOW, 1883.

Simplex Cooking Range. Walker, Turnbull & Co., *Falkirk.* GLASGOW, 1883.

Cooking Stove with Warm-Air Chamber, Thos. Waller, 47, *Fish Street Hill, E.C.* CROYDON, 1879.

Cottage Range. Wippell Bros. & Row, *Exeter.* EXETER, 1880.

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(3). Smoke Preventing Appliances.

Open Grate for consuming Smoke. James Smith, *Liverpool.* NEWCASTLE, 1882.

(4). Lighting, including Electric Lighting.

Improved Gas Burners. Bray & Co., *Blackman Lane, Leeds.* CROYDON, 1879.

Portable Gas Apparatus for Manufacturing Gas from Gasoline. F. W. Clarke's Portable Gas Apparatus Company (Limited), *Great Queen Street, London, W.C.* CROYDON, 1879.

Albo Carbon Light. William Forrest, *Newcastle-upon-Tyne.* NEWCASTLE, 1882.

Albo-Carbon Light. Osbert Henderson, *Glasgow.* GLASGOW, 1883.

Duplex Burner. T. Heron, *Manchester,* NEWCASTLE, 1882.

"Rheo-meter" Street Lamp Regulator. S. Leoni & Co., *Strand, W.C.* STAFFORD, 1878.

Hink's Duplex Lamp with Extinguisher. Mather & Armstrong, *Newcastle-upon-Tyne.* NEWCASTLE, 1882.

"Milwaukee" Glass Lantern or Hurricane Lantern. S. E, Ransome & Co., 10, *Essex Street, W.C.* CROYDON, 1879.

Gaseliers and Gas Brackets. Willey & Co., *Exeter.* EXETER, 1880.

Chappuis Daylight Reflector. Wippell Bros. & Row, 231, *High Street, Exeter.* EXETER, 1880.

(5). Ventilating Gas Burners.

No awards.

(6). Ventilators.

Method of Costless Ventilation. Peter Hinckes Bird, 1, *Norfolk Square, W.* CROYDON, 1879.

Glass Revolving and Sliding Ventilators. H. W. Cooper & Co., *London.* GLASGOW, 1883.

Air Inlet Head for Drain Ventilation. H. S. Cregeen, *Bromley.* NEWCASTLE, 1882.

"Radiator" Ventilator, with Screw Action. J. E. Ellison, *Leeds.* GLASGOW, 1883. DUBLIN, 1884.

Double Current Ventilators. Hill & Hey, *Halifax.* GLASGOW, 1883.

Outlet Ventilator. C. Kite & Co. *London.* NEWCASTLE, 1882,

Noiseless Chimney Breast Outlet Ventilator. Kite & Co., *London.* GLASGOW, 1883. DUBLIN, 1884.

Wall Inlet Ventilator. C. Kite & Co., *London.* GLASGOW, 1883. DUBLIN, 1884.

"Imperial" Ventilating Window. U. Knell, 77, *Fore Street, E.C.* CROYDON, 1879.

Morgan's Stench Exhaust. Nailsworth Foundry Company. *Bristol.* NEWCASTLE, 1882

Ventilating and Warming Appliances. G. E. Pritchett, 20, *Spring Gardens, S. W.* STAFFORD, 1878.

Ransome's Artificial Stone Air Brick. Wippell Bros. & Row, 231. *High Street, Exeter.* EXETER, 1880.

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Ornamental Inlet Ventilators. C. H. Sharp & Co., *High Holborn, E.C.* EXETER, 1880.
Boyle's Mica-Valved Outlet Ventilator. Wenham & Co., *Church Street, Croydon.* CROYDON, 1879.

CLASS IV.—PERSONAL HYGIENE, FOODS, FILTERS, AND DISINFECTANTS.

(1.) Clothing.

Crocodile Hide Leather. Borough Leather Warehouse Co., *London.* GLASGOW, 1883.
Ventilatorium Waterproof Garments. Bartrum, Harvey & Co., *London.* STAFFORD, 1878.
Ventilated Hats. W. Graham, *Dublin.* DUBLIN, 1884.
Improved shape of Boot. J. Hotblack & Son, *Norwich.* DUBLIN, 1884.
Pith Helmet. J. Morgan, *Dublin.* DUBLIN, 1884.
Rhinoceros Hide "S" Boot. Patrick Short, *Dublin.* DUBLIN, 1884.
Furs. Brooke Tyrrell, *Dublin.* DUBLIN, 1884.
"Natural" Boot for Ladies. A. Webb, *Dublin.* DUBLIN, 1884.

(2). Beds and other Furniture.

Spring Mattresses. Billington Bros., *Liverpool.* GLASGOW, 1883.
Portable Bed, with Liverpool Spring Mattress. Billington Bros., *Liverpool.* DUBLIN, 1884.
Central Tube Water Mattress. Brady & Martin, *Newcastle-upon-Tyne.* NEWCASTLE, 1882.
Bed Rest with Movable Arms. Willam Brock & Co., 177, *Fore Street, Exeter.* EXETER, 1880.
"Nonsuch" Adjustable Chair. Willam Brock & Co., 177, *Fore Street, Exeter.* EXETER, 1880.
Spring Mattress. Bussey & Co., *Museum Works, Peckham, S.E.* CROYDON, 1879.
"Excelsior" Ships' Berth. Chorlton & Dugdale, *Manchester.* GLASGOW, 1883.
Pitch Pine Lath Mattress. Chorlton & Dugdale, *Manchester.* DUBLIN, 1884.
Automaton Seat for Drapers. Colman & Glendenning, *Norwich.* EXETER, 1880.
Combination Bedstead. W. Fleming, *Dublin.* DUBLIN, 1884.
Spring Mattress. A. Gardner & Son, *Glasgow.* GLASGOW, 1883.
Invalid "Grasshopper" Couch. William Hamilton, *Brighton.* STAFFORD, 1878. NEWCASTLE, 1882.
Institution Bed, with Woven-Wire Mattress. Pearson & Co., *Dublin.* DUBLIN, 1884.
Hinged Cot. Pim Bros., *Dublin.* DUBLIN, 1884.
Furniture. Scott & Co., *Dublin.* DUBLIN, 1884.
Fernby's "Paragon" Camp Furniture. Wippell Bros. & Row, *Exeter.* EXETER, 1880.

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(3). Hospital and Sick Room Appliances.

Metallic Tubular Bedsteads and Invalid Bedrests. Thomas Allen, *St. Augustine's Parade, Bristol.* STAFFORD, 1878.

Folding Invalid Bed. Ancell Ball, *Spalding.* CROYDON, 1879.

Absorbent Cotton and Antiseptic Sponges. Burroughs, Wellcome & Co.. *London.* DUBLIN, 1884.

"Invalid's" Adjustable Bed. Chorlton & Dugdale, *Manchester.* EXETER, 1880.

Hospital Bed, fitted with Raising Appliances. Chorlton & DUGDALE *Manchester.* DUBLIN, 1884

Hospital Bed, with new Spring Mattress. Chorlton & Dugdale, *Manchester.* DUBLIN, 1884.

Self-acting Sick Bed. E. K. Groves, *Bristol.* GLASGOW, 1883.

Burn and Wound Boxes. W. B. Hilliard & Sons, *Glasgow.* GLASGOW, 1883.

Isolating Curtain. W. B. Hilliard & Sons, *Glasgow.* GLASGOW, 1883.

India Rubber Vessels for hospital use. H. A. Murton, *Newcastle-upon-Tyne.* NEWCASTLE, 1882.

China Cups and other Vessels for invalid use. Townsend & Co., *Newcastle-upon-Tyne.* NEWCASTLE, 1882.

Stypium Absorbent Antiseptic Surgical Dressings. Stephenson & Travis, *Liverpool.* DUBLIN, 1884.

(4). Domestic Appliances.

Automatic Chariot for Children. William Bowden, *London,* NEWCASTLE, 1882.

Revolving Shuttle for Sewing Machines. Bradbury & Co., *Oldham.* GLASGOW, 1883.

Compostella Fire Lights for Lighting Fires. Compostella Fire Light Company, *Fenchurch Street, E.C.,* STAFFORD, 1878.

Bower's Potato Steamer. Groom & Co., *London.* DUBLIN, 1884.

Self-Indicating Tea or Coffee Infuser. Groom & Co., *London.* DUBLIN, 1884.

Stoneware Churns. F. Grosvenor, *Glasgow.* GLASGOW, 1883.

Dough Kneading Machine. F. & C. Hancock, *Dudley, Worcester.* EXETER, 1880

New Propellor Churn. F. & C. Hancock, *Dudley, Worcester.* EXETER, 1880.

Machine for Washing and Peeling Potatoes. F. & C. Hancock, *Dudley.* NEWCASTLE, 1882.

Knitting Machines. Harrison Patent Knitting Machine Co., *Manchester.* DUBLIN, 1884.

Pendulous Food Warmers. Osbert Henderson, *Glasgow.* GLASGOW, 1883.

Various Inventions for Promoting Domestic Economy. W. H. Hilton, *Leamington.* STAFFORD, 1878.

India Rubber Gas Tubing. A. Hutchinson & Co., *Great Winchester Street, London, E.C.* EXETER, 1880.

Victoria Knitting Machine. Pim Bros. Limited, *Dublin.* DUBLIN, 1884.

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"Noiseless Ware.' Vernon's Patent China and Glass Company. *London.* GLASGOW, 1883.
Improved Housemaid's Box with Sifter. Wippell Bros. & Row, *High Street, Exeter.* EXETER, 1880.

(5). School Fittings.

School Desks with Shifting Seats. Colman & Glendenning, *Norwich.* STAFFORD, 1878.
Dual Desk, with Separate Gangway Seat. Thomas Larmouth & Co. *Salford.* STAFFORD, 1878.

(6). Gymnastic Apparatus.

Tricycles, W. Carson & Sons., *Dublin.* DUBLIN, 1884.
Tricycles. Fletcher Bros., *Dublin.* DUBLIN, 1884.

(7). Foods.

Pickles and Sauces. Beveridge & Co., *Glasgow.* GLASGOW, 1883.
Currie Powders. J. Edmunds, *London.* NEWCASTLE, 1882.
Cocoa Extract and Preparations of Chocolate. J. S. Fry & Sons, *Union Street, Bristol.* EXETER, 1880.
Indian Tea. Indian Tea Co., *Glasgow.* GLASGOW, 1883.
Mustard. Irvine & Co., *Gateshead.* NEWCASTLE, 1882. GLASGOW, 1883.
Midlothian Oat Flour. A. & R. Scott, *Glasgow.* GLASGOW. 1883.

(8). Domestic Filters.

"Bijou" Filtre Rapide. P. A. Maignen, *Great Tower Street, London, E.C.* EXETER, 1880.
Improved Filtre Rapide. P. A. Maignen, *Great Tower Street, E.C.* NEWCASTLE, 1882.
Silicated Carbon Double Chambered Table Filters. Silicated Carbon Filter Company, *Battersea, London.* EXETER, 1880.
Silicated Carbon Filtering Material. Silicated Carbon Filter Company, *London.* NEWCASTLE, 1882.
Carbonised Iron Stone Mound Filter for Water. J. A. Stephan, *Worcester.* EXETER, 1880.
Artificial Stone Filters, for Cleansing Rain Water for Domestic Use. Thorn & Co., *Stafford.* STAFFORD, 1878.

(9). Mineral Waters.

Potash, Soda and Seltzer Waters and Lemonade. British Mineral Water Company, *Glasgow.* NEWCASTLE, 1882.
Preparations of Lime Juice, Aromatic Ginger Ale, and Quinine Tonic. Carter & Co., *Old Refinery, Bristol.* EXETER, 1880.
Zoedone. (Patentee David Johnson, F.C.S.) Evans & Co., *Wrexham.* CROYDON, 1879.
Lemonade, Lime Juice, and Ginger Ale. Gulliver & Co., *Aylesbury.* CROYDON, 1879.
Seltzer Water. Jewsbury & Brown, *Manchester.* STAFFORD, 1878.
Ginger Ale and Lemonade. Newry Mineral Water Company (Limited), *Liverpool.* CROYDON, 1899.

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Seltzer, Soda, and Potash Waters, and Orange Quinine Tonic G H Skinner, 13, *North Street, Exeter*. EXETER, 1880.

(10). Soaps and other Detergents.

Soaps. S. Boyd, *Dublin*. DUBLIN, 1884.
Carbolic Soaps. F. C. Calvert & Co., *Manchester*. DUBLIN, 1884.

(11). Antiseptics and Disinfectants.

Red Cross Yellow Fluid. Antiseptic Apparatus Manufacturing Co., *London*. NEWCASTLE, 1882.
Chemical Substances used in Disinfection. S. Boyd, *Dublin*. DUBLIN, 1884.
50°/₀ Carbolic Disinfecting Powder. F. C. Calvert & Co., *Manchester*. GLASGOW, 1883.
Soluble Cresol. F. C. Calvert & Co., *Manchester*. DUBLIN, 1884.
Alum Cake. Dublin and Wicklow Manure Co., *Dublin*. DUBLIN, 1884.
Jeyes' Perfect Purifier. Jeyes' Sanitary Compound Company, *Bishopsgate Street, London, E.C.* CROYDON, 1879. NEWCASTLE, 1882. GLASGOW, 1883. DUBLIN, 1884.
Pixene. J. Wheeler, *Ilfracombe*. GLASGOW, 1883. DUBLIN, 1884.

(12) Disinfecting Apparatus.

Improved Vaporiser for Disinfecting. F. C. Calvert & Co., *Manchester*. EXETER, 1880.
Dr. Scott's Disinfecting Apparatus. Maguire & Son, *Dublin* NEWCASTLE, 1882. DUBLIN, 1884.
Lyon's Disinfector. Manlove, Alliott, Fryer & Co., *Nottingham*. NEWCASTLE, 1882.

CLASS V.—MISCELLANEOUS.

Articles of Sanitary Interest not included in the above Classes, such as :—

(1). Scientific Instruments.

Large Legible Spirit Thermometer. P. Hinckes Bird, 1, *Norfolk Square, London, N.W.* EXETER, 1880.
Instruments used by Medical Officers of Health. Brady & Martin, *Newcastle-upon-Tyne*. NEWCASTLE, 1882.
New Oven Pyrometer. Joseph Davis & Co., *London*. NEWCASTLE, 1882.
Thermometrical Instruments. G. E. Pritchett, 20, *Spring Gardens, London, S.W.* STAFFORD, 1878.
Barometrical and Thermometrical Instruments. G. E. Pritchett, 20, *Spring Gardens, London, S.W.* CROYDON, 1879.

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Improvements in Thermometrical and Barometrical Instruments, G. E. Pritchett, 20, *Spring Gardens, S.W.* EXETER, 1880.
Webster's Photometer. Webster & Co., *Nottingham.* CROYDON, 1879.

(2). Books and Periodicals.

Exhibit of Drawings and Books Relating to Disposal of Sewage in Paris. A. Durand Claye, *Paris.* GLASGOW, 1883.
Publications. Ladies' Sanitary Association, *Berners Street, London, W.* STAFFORD, 1878.
Sanitary Publications. Smith, Elder, & Co., *London.* NEWCASTLE, 1882. GLASGOW, 1883. DUBLIN, 1884.

(3). Models and Drawings.

No awards.

(4). Prevention of Accidents.

Leander Life Belt. J. W. Elvery & Co., *Dublin.* DUBLIN, 1884.
Method of Rendering Timber Non-inflammable. A. Gardner & Son, *Glasgow.* GLASGOW, 1883.
Safety Belt Shippers. Selig, Sonnenthal & Co. (Limited), *Lambeth Hill, Queen Victoria Street, London, E.C.* CROYDON, 1879.

(5). Respirators and Face Guards for Unhealthy Occupations.

No awards.

(6). Fire Preventing Appliances.

Dicks' L'Extincteur. J. Hildesheim, *Glasgow.* GLASGOW, 1883.
Chemical Fire Exterminator. J. Sinclair, 104, *Leadenhall Street, London, E.C.* CROYDON, 1879.

(7). Methods for the Disposal of the Dead.

"Earth to Earth" Coffins. London Necropolis Company, *Strand, London, W.C.* STAFFORD, 1878.
Folding Bier and Car for Simplifying Funerals. S. Stretton, *Kidderminster.* CROYDON, 1879.

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ALPHABETICAL LIST OF MEDALS AWARDED AT THE EXHIBITIONS.

RICHARDSON MEDAL.

Messrs. Mather & Armstrong, *Newcastle-upon-Tyne*, for Siemens's Regenerative Gas Burner. NEWCASTLE, 1882.

Silicate Paint Company, *Cannon Street, E.C.*, for Griffiths' Patent White. STAFFORD, 1878.

SILVER MEDAL.

Offered by the Exeter Gas Company.

Sanitary and Economic Supply Association, for Dr. Bond's Euthermic Ventilating Gas Stove. EXETER, 1880.

Wright, J. & Co., *Birmingham*, for Eureka Gas Cooking Stove. DUBLIN, 1884.

MEDALS AND SPECIAL CERTIFICATES.

In cases where awards are made at subsequent Exhibitions for the same Exhibits, only the name of the town and date are given. Exhibits which have already received Medals at previous Exhibitions of the Institute are excluded from awards of Medals; but those Exhibits to which a second Medal would otherwise be awarded receive Special Certificates, and these are distinguished in the following list by asterisks placed against the name of the town at which the Exhibition was held.

Aluminium Crown Metal Co., *Glasgow.*, for Aluminium Crown Metal, GLASGOW, 1883.

Aveling & Porter, *Rochester*, for Improved Six-Ton Steam Road Roller. CROYDON, 1879.

Bean, A. T., 5, *Cannon Row, S.W.*, for Direct Acting Valveless Waste Preventer. EXETER, 1880.

Billing & Co., *Hatton Garden, E.C.*, for Apparatus for Cooking by Gas. STAFFORD, 1878. *CROYDON, 1879.

Borwell, J., *Britannia Foundry, Burton-on-Trent*, for Improved Washer, with table complete. LEAMINGTON, 1877.

Bostel, D. T., *Duke Street, Brighton*, for Excelsior Water Closet. LEAMINGTON, 1877. *STAFFORD, 1878.

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Boulnois H., Percy, *Portsmouth* for "Acme" Sewer Pipes. GLASGOW, 1883.

Bradford, T. & Co., *High Holborn, W.C.*, for New "Shuttle" Steam Power Washing Machine. LEAMINGTON, 1877. *STAFFORD, 1878.

" " for Washing Machines. NEWCASTLE, 1882. *GLASGOW, 1883. *DUBLIN, 1884.

British Sanitary Company, *Glasgow*, for Dry Earth Closet. NEWCASTLE, 1882. *GLASGOW, 1883. *DUBLIN, 1884.

Brown, A. & Co., *Glasgow*, for "Stott" Gas Burner *GLASGOW, 1883.

Buchan, W. P., *Glasgow*, for his exhibit of Sanitary Appliances. GLASGOW, 1883.

Burroughs, Wellcome & Co., *London*, for Powders for Peptonizing Milk. DUBLIN, 1884.

Calvert & Co., *Bradford*, for Calvert's Carbolic Acid for disinfecting purposes. LEAMINGTON, 1877. *CROYDON, 1879. *EXETER, 1880. *GLASGOW, 1883. *DUBLIN, 1884.

Carter, J., 6*a*, *Cavendish Street, W.*, for Invalid Furniture. EXETER, 1880.

Chorlton & Dugdale, *Manchester*, for Excelsior Spring Mattress. LEAMINGTON, 1877. *STAFFORD, 1878. *CROYDON, 1879. *EXETER, 1880. *NEWCASTLE, 1882. *GLASGOW, 1883. *DUBLIN, 1884.

" " for "Swing" Woven Wire Mattress. DUBLIN, 1884.

Cliff, Joseph & Sons, *Leeds*, for Porcelain Bath. GLASGOW, 1883.

Colman & Glendenning, *Norwich*, for School Furniture. EXETER, 1880.

Craig, J. & M., *Kilmarnock, N.B.*, for Enamelled Fireclay Sinks. DUBLIN, 1884.

Dick, Alex., *London*, for Delta Metal. GLASGOW, 1883.

Donegal Industrial Fund, for Innocuously-dyed Woollen Goods. DUBLIN, 1884.

Doulton & Co., *Lambeth, London*, for Stanford's Joints for Stoneware Pipes. STAFFORD, 1878. *EXETER, 1880.

" " for Anti-Percussion High Pressure Valves. CROYDON, 1879. *EXETER, 1880. *GLASGOW, 1883. *DUBLIN, 1884.

" " for Ventilating Tile Stove. EXETER, 1880. *NEWCASTLE, 1882. *GLASGOW, 1883. *DUBLIN, 1884.

" " for Anti-Percussion Ball Valve. NEWCASTLE, 1882.

" " for Art Pottery. DUBLIN, 1884.

Duncan, Maj. F., *The Common, Woolwich*, for Ambulance Wheeled Litter. STAFFORD, 1878.

Edmunson, J. & Co., *Dublin*, for their exhibit of Swann's Incandescent Electric Lights. DUBLIN, 1884.

Ellison, J. E., *Leeds*, for Conical Ventilators. STAFFORD, 1878. *CROYDON, 1879. *GLASGOW, 1883. *DUBLIN, 1884.

Fraser Bros., *Commercial Road, E.*, for Portable Disinfecting Apparatus. CROYDON, 1879

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Galbraith, T., *Crawford Square, Londonderry*, for Hot-Air Bath. LEAMINGTON, 1877.

Hall, John & Co., *Stourbridge*. for Fire-Clay Enamelled Bath. GLASGOW, 1883.

Hamilton & Co., *Leadenhall Street, E.C.*, for Prismoidal Pavement and Floor Lights. CROYDON, 1879.

Hancock, F. & C., *Dudley, Worcester*, for Machine for Washing and Cooling Butter. LEAMINGTON, 1877. *STAFFORD, 1878.

" for Machines for Domestic use. GLASGOW, 1883.

Haresceugh, B. B. & Co., *Bentinck Street, Leeds*, for Excreta Pail (oak) with Spring Lid. LEAMINGTON, 1877. *STAFFORD, 1878.

Harris, G. H., *Bristol Street, Birmingham*, for Economical Cooking Range. LEAMINGTON, 1877. *STAFFORD, 1878.

Hassall & Singeton, *Birmingham*, for Phœnix Portable Range, and the Birmingham Range with Reducible Fire without Gas. STAFFORD, 1878.

Hayward, Tyler & Co., *London*, for Full-flush Valveless Closet. NEWCASTLE, 1882.

Heap, R. R., *Manchester*, for Dry Earth or Ashes Closet. GLASGOW, 1883 DUBLIN, 1884.

Hilliard, W. B. & Sons, *Glasgow*, for Hospital and Sick Room Appliances. GLASGOW, 1883.

Hunt, Nathan, *Bristol*, for Auto-Pneumatic Ventilation. EXETER, 1880.

Keith, J., *London and Edinburgh*, for Challenge Hot-water Boiler. GLASGOW, 1883.

Lascelles, W. H., *Bunhill Row, E.C.*, for Concrete Bath in one piece. CROYDON, 1879. *EXETER, 1880.

Le Grand & Sutcliffe, *Bunhill Row, E.C.*, for Improvements in Well Sinking Apparatus. LEAMINGTON, 1877. *CROYDON, 1879.

Leoni, S. & Co., *Strand*, for Apparatus for Cooking by Gas. STAFFORD, 1878.

Mackey, Mackey & Co., *London*, for Chemical Substances used for Disinfection. DUBLIN, 1884.

Maguire & Son, *Dublin*, for their exhibit of Sanitary and Domestic Appliances. DUBLIN, 1884.

Maignen, P. A., 20 & 23, *Great Tower Street, E.C.*, for Filtre Rapide. CROYDON, 1879. *EXETER, 1880. *GLASGOW, 1883. *DUBLIN, 1884.

Manlove, Alliot, Fryer & Co., *Nottingham*, for Fryer's Destructor, Fryer's Carbonizer, and Firman's Dessicating and Rendering Apparatus. NEWCASTLE, 1882.

Mather & Armstrong, *Newcastle-upon-Tyne*, for Sieman's Regenerative Gas Burner. NEWCASTLE, 1882.

Meyer, H. C., *New York*, Sanitary Engineer of New York Newspaper. GLASGOW, 1883.

Moore, J., *St. James' Walk, Clerkenwell, E.C.*, for Glass Louvre Ventilators. EXETER, 1880.

Morris, Little & Co., *Doncaster*, for Little's Soluble Phenyle. STAFFORD, 1878.

Morrison, W. B., *Glasgow*, for Wedgwood Ornamental Tiles. GLASGOW, 1883.

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Moser, L., *Southampton.*, for Dry Closet, suitable for Ashes or Disinfecting Powder. EXETER, 1880.

Moule's Patent Earth Closet Company, 5*a*, *Garrick Street, W.C.*, for Earth Closets. STAFFORD, 1878. *CROYDON, 1879.

Musgrave & Co., *Belfast*, for Slow Combustion Stoves. DUBLIN, 1884.

Orr, J. B. & Co., *Charlton, London*, for Leadless "Charlton White" Paint and Dryers. GLASGOW, 1883.

Parker, J., *Woodstock, Oxford*, for Dry Earth Closet. LEAMINGTON, 1877.

Pim Bros., *Dublin*, for their Exhibit of Furniture. DUBLIN, 1884.

Pocock, Bros., *Southwark Bridge Road*, for "Universal" Invalid Tubular Water and Air Bed. STAFFORD, 1878. *CROYDON, 1879.

Pritchett,, G. E., 20, *Spring Gardens, S.W.*, for Economic Hollow Flooring. STAFFORD, 1878. *CROYDON, 1879.

Read, Jefferson, *Birmingham*, for Arcanum Process of Silver Plating Steel. CROYDON, 1879.

Roberts, C. G., *Haslemere, Surrey*, for Rain-water Separator. NEWCASTLE, 1882. *GLASGOW, 1883.

Ross, J. A. G., *Newcastle-upon-Tyne*, for Silicate Cotton (Slag-wool). NEWCASTLE, 1882.

Rothwell, W., *Bolton*, for Flat Web Knitting Machine, and Rothwell Knitting Machines. DUBLIN, 1884.

Sanitary Appliance Company, *Salford*, for Portable Cinder Sifting Ash Closet, with Soil Pail. STAFFORD, 1878. *CROYDON, 1879.

Sanitary & Economic Supply Association, *Gloucester*, for Dr. Bond's Euthermic Gas Stove. EXETER, 1880.

Sanitas Company (Limited), *London*, for Sanitas Oil. NEWCASTLE, 1882.

Scottish Asbestos Co., *Glasgow*, for Scottish Asbestos. GLASGOW, 1883.

Shanks & Co., *Barrhead, N.B.*, for Siphon-action Water Waste Preventer. DUBLIN, 1884.

Shaw, A. & Son, *Glasgow*, for "Sine quâ non" Open and Close Fire. Range. GLASGOW, 1883.

Silicate Paint Company, *Cannon Street, E.C.*, for Griffiths' White, and for their preparations of Silicate Paint, Enamel Paint, and Petrifying Liquids. STAFFORD, 1878.

Sinclair, G., *Leith*, for Mechanical Stoker. GLASGOW, 1883.

Sinclair, J., *Leadenhall Street, E.C.*, for Tyndall's Smoke Respirator. CROYDON, 1879.

Singer Manufacturing Company, *London*, for Friction Driving Attachment for Sewing Machines. GLASGOW, 1883.

Smallman, John L., *Dublin*, for Stott's Mercury Gas Governor. *DUBLIN, 1884.

Société Française D'Hygiène, *Paris*, for Chemical Preparations and Apparatus. LEAMINGTON, 1877.

" " *Paris*, for Books on Hygiène. NEWCASTLE, 1882.

Spongy Iron Water Purifying Company, *Oxford Street, W.C.*, for Bischof's Spongy Iron Filter. LEAMINGTON, 1877.

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Stewart, J., Sen., *Glasgow*, for Stoneware Disconnecting Traps. GLASGOW, 1883.

Stewart, J., Sen., *Glasgow*, for Stoneware Pipes with Stanford's Joint. *GLASGOW, 1883.

Stott, James & Co., *Oldham*, for Mercury Gas Governor. NEWCASTLE, 1882.

Tylor & Sons, *Newgate Street, E.C.*, for Flushing Rim Lavatory Basin and Apparatus. EXETER, 1880.

Walker, Chas. W., *Wandsworth Common*, for Acid Pump and Syphon. CROYDON, 1879.

Walker, Turnbull & Co., *Falkirk*, for Artizan Cooking Range. GLASGOW, 1883.

Ward, O. D., *London*, for Household Water Closet. NEWCASTLE, 1882.

" " for Bean's Direct Acting Valveless Waste Preventor. *NEWCASTLE, 1882.

Webb, H. Chalk, *Worcester*, for Colouring Patterns through the Substance of Wood. EXETER, 1880.

Wenham, W. P., *Church Street, Croydon*, for Improved Open or Close Range Kitchener. CROYDON, 1879.

Wentworth, F. & Co., *London*, for "Kredemnon" Life-saving Garments. GLASGOW, 1883.

Whyte & Bradford, *Bowness*, for Cooking Range with Revolving Fire for the Prevention of Smoke. GLASGOW, 1883.

Wilkinson, W. B. & Co., *Newcastle-upon-Tyne*, for Damp-proof Concrete Pavement. NEWCASTLE, 1882.

Willcocks & Co., *Burmantofts, Leeds*, for Silica Glazed and Enamelled Fire Clay Bricks and Fäience. CROYDON, 1879.

Wilson Engineering Company, *Holborn, W.C.*, for Wilson Portable Close Cooking Range. EXETER, 1880.

" " for Improved Wilson Range. with Steel Boiler and non-conducting Jacketing. NEWCASTLE, 1882. *GLASGOW, 1883. *DUBLIN, 1884.

Wippell Bros. & Row, 231, *High Street, Exeter*, for Moule's Earth Closet. *EXETER, 1880.

Woollams & Co., *High Street, Marylebone*, for Paper Hangings free from Arsenic. CROYDON, 1879. *NEWCASTLE, 1882.

" " for Non-Arsenical Pigments and Paper Hangings. *GLASGOW, 1883.

Wright, J. & Co., *Birmingham*, for "Eureka" Gas Cooking Stove. DUBLIN, 1884.

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ALPHABETICAL LIST OF CERTIFICATES AWARDED AT THE EXHIBITIONS.

Adams, R., 7, *Great Dover Street, S.E.*, for Adjustable Shoe, and Regulating Spring Hinge for Swinging Doors. CROYDON, 1879.

" " for Fanlight Openers and Casement Fasteners. CROYDON, 1879.

" " for the Norton Door Spring DUBLIN, 1884.

" " for Adjustable Pivot for Fanlights. DUBLIN, 1884.

Allen, Thomas, *St. Augustine's Parade, Bristol*, for Metallic Tubular Bedsteads and Invalid Bedrests. STAFFORD, 1878.

Angell, A. T., *London*, for Air-tight Man-hole Door. NEWCASTLE, 1882. GLASGOW, 1883.

Antiseptic Apparatus Manufacturing Co. (Limited), for Red Cross Yellow Fluid. NEWCASTLE, 1882.

Arden, Hill & Co., *Birmingham*, for Solid Flame Boiling Stove. NEWCASTLE, 1882.

" " for Gas Cooking Stove, lined with White Tiles. DUBLIN, 1884.

Baird, W., *Dublin*, for Butler's Sink, lined with Block Tin. DUBLIN, 1884.

" " for White Enamelled Fireclay Sinks. DUBLIN, 1884.

" " for Bath, with Shower Douche and Spray Fittings combined. DUBLIN, 1884.

" " for Lavatory, with Shampooing Apparatus. DUBLIN, 1884.

" " for Hydraulic Ram. DUBLIN, 1884.

" " for Improved Horizontal-Pull Fittings for Baths and Lavatories. DUBLIN, 1884.

Baird, Thompson & Co., *Glasgow*, for Watts' Asphyxiator for Testing Drains with Smoke. DUBLIN, 1884.

Ball, Ancell, *Spalding*, for Folding Invalid Bed. CROYDON, 1879.

Bartrum, Harvey, & Co., *London*, for Ventilatorium Waterproof Garments. STAFFORD, 1878.

Beard, Dent, & Hellyer, 21, *Newcastle Street, W.C.*, for Artizan Closet. CROYDON, 1879.

" " for Ventilating Drain Syphon CROYDON, 1879.

Beveridge & Co., *Glasgow*, for Pickles and Sauces. GLASGOW, 1883.

Billington Bros., *Liverpool*, for Spring Mattresses. GLASGOW, 1883.

" " for Portable Bed, with Liverpool Spring Mattress. DUBLIN, 1884.

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Binnie, J., *Gartcosh, Glasgow*, for Salt-glazed Fire-clay Sewer Pipes. GLASGOW, 1883.

Bird, Peter Hinckes, 1, *Norfolk Square, N.W.*, for Method of Costless Ventilation. CROYDON, 1879.

" " for Large Legible Spirit Thermometer. EXETER, 1880.

Borough Leather Warehouse Company, *London*, for Crocodile Hide Leather. GLASGOW, 1883.

Bourtreehill Coal Co., Dreghorn, *Ayrshire*, for Stoneware Drain Pipes. DUBLIN, 1884.

" " for White Enamelled Fireclay Sinks. DUBLIN, 1884.

" " for White Enamelled Bricks. DUBLIN, 1884.

Bowden, William, *London*, for Automatic Chariot for Children. NEWCASTLE, 1882.

Boyd, S., *Dublin*, for Soaps. DUBLIN, 1884.

" " for Chemicals used in Disinfection. DUBLIN, 1884.

Bradbury & Co., *Oldham*, for Revolving Shuttle for Sewing Machines. GLASGOW, 1883.

Brady & Martin, *Newcastle-upon-Tyne*, for Central Tube Water Mattress. NEWCASTLE, 1882.

" " for Instruments used by Medical Officers of Health. NEWCASTLE, 1882.

Braithwaite & Co., *Leeds*, for Syphon for Water Closet Cisterns. CROYDON, 1879.

Branksea Island Pottery Company (Limited), *Poole, Dorset*, for Stoneware Pipes. EXETER, 1880.

Bray & Co., *Blackman Lane, Leeds*, for Improved Gas Burners. CROYDON, 1879.

British and Foreign Mineral Water Company, *Glasgow*, for Potash, Soda and Seltzer Waters, and Lemonade. NEWCASTLE, 1882.

British Sanitary Company, *Glasgow*, for Self-Acting Earth Closet. EXETER, 1880.

Brock, W. & Co., 177, *Fore Street, Exeter*, for Bed Rest with Moveable Arms. EXETER, 1880.

" " for "Nonsuch" Adjustable Chair. EXETER, 1880.

Buchan, W. P., *Glasgow*, for Improved Drain-pipe, with Access Cover. NEWCASTLE, 1882.

" " for Disconnecting Drain-trap. NEWCASTLE, 1882. GLASGOW, 1883.

" " for Grease Trap for Kitchen Sinks. GLASGOW, 1883.

Burroughs, Wellcome & Co., *London*, for Absorbent Cotton and Antiseptic Sponges. DUBLIN, 1884.

Bussey & Co., *Museum Works, Peckham, S.E.*, for Patent Spring Mattress. CROYDON, 1879.

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Cadle, C., *Dublin*, for Silicate Cotton Composition for covering Steam Pipes. DUBLIN, 1884.

Calvert, F. C., & Co., *Bradford*, for Improved Vaporiser for Disinfecting. EXETER, 1880.

" " for 50°/. Carbolic Disinfecting Powder. GLASGOW, 1883.

" " for Carbolic Soaps. DUBLIN, 1884.

" " for Soluble Cresol. DUBLIN, 1884.

Candy & Co., *Newton Abbot*, for Granite Vitrified Bricks and Paving. EXETER, 1880.

Capper, Son & Co., *London*, for Brian Jones's Joint for connecting Closet with Soil-pipe. NEWCASTLE, 1882.

Carron Company, *Falkirk*, *N.B.*, for Combined Close Fire and Gas Cooking Range. GLASGOW, 1883.

Carson, W. & Sons, *Dublin*, for their exhibit of Tricycles. DUBLIN, 1884.

" " for Willesden Waterproof Paper and Canvas. DUBLIN, 1884.

" " for Tortoise Slow Combustion Stoves. DUBLIN, 1884.

Carter & Co., *Old Refinery*, *Bristol*, for Preparations of Lime Juice, Aromatic Ginger Ale, and Quinine Tonic. EXETER, 1880.

Chorlton & Dugdale, *Manchester*, for "Sun-light Stove." EXETER, 1880.

" " for "Invalids'" Adjustable Bed. EXETER, 1880.

" " for "Excelsior" Ship's Berth. GLASGOW, 1883.

" " for Hospital Bed, fitted with Raising Appliances. DUBLIN, 1884.

" " for Pitch Pine Lath Mattress. DUBLIN, 1884.

" " for Hospital Bed, with New Spring Mattress. DUBLIN, 1884.

Clarke, F. W., Portable Gas Apparatus Company (Limited), *Great Queen Street*, *W.C.*, for Portable Gas Apparatus for Manufacturing Gas from Gasoline. CROYDON, 1879.

Colman & Glendenning, *Norwich*, for School Desks with Shifting Seats. STAFFORD, 1878.

" " for Automaton Seat for Drapers. EXETER, 1880.

Compostella Fire-Light Company, *Fenchurch Street*, *E.C.*, for Compostella Fire Lights for Lighting Fires. STAFFORD, 1878.

Constantine, T. J., *Fleet Street*, *E.C.*, for Devonshire Cooking Range. EXETER, 1880.

Cooper, H. W. & Co., *London*, for Glass Revolving and Sliding Ventilators. GLASGOW, 1883.

Cordingley, T. & Sons, *Bradford*, for Granite Concrete Pavement. DUBLIN, 1884.

Craig, J. & M., *Kilmarnock*, for Buchan's Trap. EXETER, 1880.

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Craig, J. & M., *Kilmarnock*, for Maguire's Cradle Joint for Drain pipes. NEWCASTLE, 1882.
" " for Buchan's Drain-trap and Drain-pipes, with Access Cover. NEWCASTLE, 1882.
" " for White Enamelled Fire-Clay Sinks. NEWCASTLE, 1882. GLASGOW, 1883.
" " for Stoneware Disconnecting Traps. GLASGOW, 1883.
" " for White Enamelled Bricks. DUBLIN, 1884.
" " for Buchan's Disconnecting Trap. DUBLIN, 1884.

Cregeen, H. S., *Bromley*, for Air Inlet Head for Drain Ventilation. NEWCASTLE, 1882.

Davis, Joseph & Co., *London*, for New Oven Pyrometer. NEWCASTLE, 1882.

Dinning & Cooke, *Newcastle-upon-Tyne*, for Cast Iron Channels for Stable Drainage. NEWCASTLE, 1882.
" " for George's Calorigen. NEWCASTLE, 1882.
" " for Jennings's Universal Shampooing Apparatus. NEWCASTLE, 1882.
" " for Grates, Mantel-pieces, and Over-mantels. NEWCASTLE, 1882.

Doulton & Co., *Lambeth*, *London*, for Decorative Tiles for Covering Walls and Floors. CROYDON, 1879.
" " for Disconnecting Gully, with back and side Entrances and iron grating. CROYDON, 1879.
" " for Economical Flush-Out Closet. EXETER, 1880.
" " for Anti-Percussion High-pressure Bib Valves. NEWCASTLE, 1882.
" " for Bath Locking Valves, for preventing waste of water. NEWCASTLE, 1882. DUBLIN, 1884.
" " for Latham's Flap Valve. NEWCASTLE, 1882.
" " for Joint for Drain-pipes. NEWCASTLE, 1882.
" " for Reversible Inlet Gully, with Dished Stoneware Cover and Iron Grating. NEWCASTLE, 1882.
" " for "Lambeth" Flush-out Closet. NEWCASTLE, 1882. GLASGOW, 1883.
" " for Tip-up Lavatory Basin. NEWCASTLE, 1882.
" " for "Lambeth" Trough Closet with Automatic Flush Tank. GLASGOW, 1883.
" " for Silicon Tread for Steps. GLASGOW, 1883. DUBLIN, 1884.
" " for Glazed Ware Mantelpiece, with Slow Combustion Grate. DUBLIN, 1884.
" " for Vacuum Flushing Cistern for Closet, with Seat-action Arrangement. DUBLIN, 1884.

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Doulton & Co., *Lambeth, London*, for cheap Glazed Stoneware Sinks. DUBLIN, 1884.
" " for Lambeth Combination Water-closet. DUBLIN, 1884.
" " for Enamelled Ware Open Channels for Manholes. DUBLIN, 1884.
" " for Manhole for Drains, with connections complete. DUBLIN, 1884.
" " for London-made Stoneware Pipes. DUBLIN, 1884.
Dublin & Wicklow Manure Co., for Alum Cake. DUBLIN, 1884.
Durand Claye, A., *Paris*, for Drawings and Books Relating to Disposal of Sewage in Paris. GLASGOW, 1883.
Edmunds, J., *London*, for Currie Powders. NEWCASTLE, 1882.
Edwards, J. C., *Trefynant, Ruabon*, for Dean's External Drain Traps, with moveable receptacle. CROYDON, 1879.
Ellison, J. E., *Leeds*, for "Radiator" Ventilator, with Screw Action. GLASGOW, 1883. DUBLIN, 1884.
Elvery, J. W. & Co., *Dublin*, for the Leander Life Belt. DUBLIN, 1884.
" " for Gentlemen's Ventilated Waterproof Overcoats. DUBLIN, 1884.
Evans & Co., *Wrexham* for Zoedone. (Patentee David Johnson, F.C.S.) CROYDON, 1879.
Fell, J. & Co., *Wolverhampton*, for Clark's Anti-splash Tip-up Lavatory Basin. NEWCASTLE, 1882.
" " for Smith's Cast Lead Syphon Traps. NEWCASTLE, 1882.
" " for Water-taps. NEWCASTLE, 1882.
Finch & Co., 181, *High Holborn, W.C.*, for Large Way Waste Plug, with Protective Cover. CROYDON, 1879.
Fleming, W., *Dublin*, for the Combination Bedstead. DUBLIN, 1884.
Fletcher Bros., *Dublin*, for exhibit of Tricycles. DUBLIN, 1884.
Forrest, William, *Newcastle-upon-Tyne*, for The Albo Carbon Light. NEWCASTLE, 1882.
Fry, J. S. & Sons, *Union Street, Bristol*, for Cocoa Extract and Preparations of Chocolate. EXETER, 1880.
Gandy, M., *Liverpool*, for Cotton Machine Belting. GLASGOW, 1883.
" " for Steil's Fastener for Machine Belting. GLASGOW, 1883.
Gardner, A. & Son, *Glasgow*, for Spring Mattress. GLASGOW, 1883.
" " for Parquet Flooring. GLASGOW, 1883.
" " for Method of Rendering Timber Non-inflammable. GLASGOW, 1883.
Garton & King, *Exeter*, for Vowel E. Bradford's Family Washing Machine. EXETER, 1880.
Gilbert, E. & A. E., *Broughty Ferry, Forfarshire*, for Improved Seat for Water Closets. GLASGOW, 1883.
Gillow & Co., *Oxford Street, W.*, for Lavatory. STAFFORD, 1878.
Graham, W., *Dublin*, for Ventilated Hats. DUBLIN, 1884.

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Groom & Co., *London*, for Bower's Potato Steamer. DUBLIN, 1884.
" " for Self-indicating Tea or Coffee Infuser. DUBLIN, 1884.
Grosvenor, F., *Glasgow*, for Stoneware Churns. GLASGOW, 1883.
Groves, E. K., *Bristol*, for Self-acting Sick Bed. GLASGOW, 1883.
Gulliver & Co., *Aylesbury*, for Lemonade, Lime Juice, and Ginger Ale. CROYDON, 1879.
Hamilton, W., *Brighton*, for Invalid "Grasshopper" Couch. STAFFORD, 1878. NEWCASTLE, 1882.
Hammond & Hussey, *High Street, Croydon*, for Hornibrook's Catchment Grating for Steep Gradients. CROYDON, 1879.
Hancock, F. & C., *Dudley, Worcester*, for New Propellor Churn. EXETER, 1880.
" " for Dough Kneading Machine. EXETER, 1880.
" " for Machine for Washing and Peeling Potatoes. NEWCASTLE, 1882.
Harriman, W., & Co., *Blaydon-upon-Tyne*, for Fowler's Water-closet. NEWCASTLE, 1882.
Harrison Patent Knitting Machine Co., *Manchester*, for Knitting Machines. DUBLIN, 1884.
Harrisson. T. Harnett, *Liverpool*, for Iron Basket Sewage-strainer. GLASGOW, 1883.
" " for Improved Method of Connecting Lead Pipes with Stoneware Pipes. GLASGOW, 1883.
Hayward, Tyler & Co., *London*, for Shower and Douche Bracket. NEWCASTLE, 1882.
Headley & Sons, *Cambridge*, for Hose Reel. CROYDON, 1879.
Henderson, Osbert, *Glasgow*, for Albo-Carbon Light. GLASGOW, 1883.
" " for Pendulous Food Warmers. GLASGOW, 1883.
Heron, T., *Manchester*, for Duplex Burner. NEWCASTLE, 1882.
Hildesheim, J., *Glasgow*, for Dicks' L'Extincteur. GLASGOW, 1883.
Hill & Hey, *Halifax*, for Double Current Ventilators. GLASGOW, 1883.
Hilliard, W. B. & Sons, *Glasgow*, for Isolating Curtain. GLASGOW, 1883.
" " for Burn and Wound Boxes. GLASGOW, 1883.
Hilton, W. H., *Leamington*, for various Inventions for Promoting Domestic Economy. STAFFORD, 1878.
Hotblack, J. & Son, *Norwich*, for an Improved Shape of Boot. DUBLIN, 1884.
Hutchinson, A. & Co., *Great Winchester Street, E.C.*, for India Rubber Gas Tubing. EXETER, 1880.
Hydes & Wigfull, *Sheffield*, for Tortoise Slow Combustion Stoves. GLASGOW, 1883.
" " for Tortoise Laundry Stove. GLASGOW, 1883.
Hygienic Stove and Grate Company, 15, *Peel Buildings, Birmingham*, for "Eagle" Sanitary Trap, for superseding Bell Traps. CROYDON, 1879.

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Indian Tea Company, *Glasgow*, for Indian Tea. GLASGOW, 1883.
Irvine & Co., *Gateshead*, for Mustard. NEWCASTLE, 1882. GLASGOW, 1883.
Jennings, G., *Stangate, London*, for "Artizans Dwellings Sink." CROYDON, 1879.
" " for Universal Shampooing Apparatus. CROYDON, 1879.
Jewsbury & Brown, *Manchester*, for Seltzer Water. STAFFORD, 1878.
Jeyes' Sanitary Compound Company, *Cannon Street, E.C.*, for Jeyes' Perfect Purifier. CROYDON, 1879. NEWCASTLE, 1882. GLASGOW, 1883. DUBLIN, 1884.
Kirsop & Co., *Newcastle-upon-Tyne*, for Paragon Washing Machine, with Canadian Washer. NEWCASTLE, 1882.
Kite, C. & Co. *London*, for Outlet Ventilator. NEWCASTLE, 1882.
" " for Noiseless Chimney Breast Outlet Venti-
" " for Wall Inlet Ventilator. GLASGOW, 1883. DUBLIN, 1884.
Knell, U., 77, *Fore Street, E.C.*, for "Imperial" Ventilating Window. CROYDON, 1879.
Ladies' Sanitary Association, *Berners Street, W.*, for Publications. STAFFORD, 1878.
Larmouth, Thomas & Co., *Salford*, for Dual Desk, with Separate Gangway Seat. STAFFORD, 1878.
Leggott, W. & R., *Bradford*, for Opener for Fanlight and Skylights. GLASGOW, 1883. DUBLIN, 1884.
Leoni, S. & Co., *Strand, W.C.*, for "Rheometer" Street Lamp Regulator, STAFFORD, 1878.
Lewis, Mrs. A., *Manchester*, for Tin Cooking Utensils. CROYDON, 1879.
London Necropolis Company, *Strand, W.C.*, for "Earth to Earth" Coffins. STAFFORD, 1878.
McCallum, J. B., *Stafford*, for Improved Non-Absorbent Tub or Pail Van. EXETER, 1880.
McGeoch, W. & Co., *Glasgow*, for Dow's Close and Open Fire Cooking Range. GLASGOW, 1883.
Maguire & Son, *Dublin*, for Dr. Scott's Disinfecting Apparatus. NEWCASTLE, 1882. DUBLIN, 1884.
" " for White Enamelled Fireclay Sinks. DUBLIN, 1884.
" " for Cast-iron Drain Pipes, coated with Angus Smith's Preparation. DUBLIN, 1884.
" " for Marsden Tiling for Wall Decoration. DUBLIN, 1884.
" " for New Laundry Stove and Copper Boiler. DUBLIN, 1884.
Maignen, P. A., 20 & 23, *Great Tower Street, E.C.*, for "Bijou" Filtre Rapide. EXETER, 1880.
" " for Improved Filtre Rapide. NEWCASTLE. 1882.
Maling, C. T., *Newcastle-upon-Tyne*, for Sanitary Earthenware. NEWCASTLE, 1882.
" " for Lavatory Basin with Flushing Rim. NEWCASTLE, 1882.

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Manlove, Alliott, Fryer & Co., *Nottingham*, for Lyon's Disinfector. NEWCASTLE, 1882.

Mather & Armstrong, *Newcastle-upon-Tyne*, for Hink's Duplex Lamp, with Extinguisher. NEWCASTLE, 1882.

" " for Steam Heating Apparatus, combining heating and ventilating. NEWCASTLE, 1882.

Mitchell, James, *Newcastle-upon-Tyne*, for Mitchell's Steam Washer. NEWCASTLE, 1882.

Morgan, J., *Dublin*, for Pith Helmet. DUBLIN, 1884.

Morrison, W. B., *Glasgow*, for "National" Water Closet. GLASGOW, 1883.

Murton, H. A., *Newcastle-upon-Tyne*, for Indiarubber Vessels for hospital use. NEWCASTLE, 1882.

Nailsworth Foundry Company, *Bristol*, for Morgan's Stench Exhaust. NEWCASTLE, 1882.

Newry Mineral Water Company (Limited), *Liverpool*, for Ginger Ale and Lemonade. CROYDON, 1879.

Oates & Green, *Horley Green Fire Clay Works*, *Halifax*, for Drain-cleaning Rods, and Stoneware Horse Manger. STAFFORD, 1878.

Onions, J. C., (Limited), *Birmingham*, for Moser's Self-Acting Dry Closet. CROYDON, 1879.

Parker, J., *Woodstock*, for Dry Earth Commode without Separator. EXETER, 1880.

Patent Victoria Stone Company, *Kingsland Road*, *E.*, for Artificial Stone Tubes. CROYDON, 1879.

Pearson & Co., *Dublin*, for the Institution Bed with Woven-Wire Mattress. DUBLIN, 1884.

Pennycook Patent Glazing and Engineering Co., *Glasgow*, for the system of Glazing without Putty. GLASGOW, 1883.

DUBLIN, 1884.

Pim Bros., Limited, *Dublin*, for the Victoria Knitting Machine. DUBLIN, 1884.

" " for the Hinged Cot. DUBLIN, 1884.

Potts & Co., *Handsworth*, *Birmingham*, for Edinburgh Air-Chambered Sewer Trap. STAFFORD, 1878.

Pritchett, G. E., 20, *Spring Gardens*, *S.W.*, for Warming and Ventilating Appliances. STAFFORD, 1878.

" " for Thermometrical Instruments. STAFFORD, 1878.

" " for Barometrical and Thermometrical Instruments. CROYDON, 1879.

" " for Corrugated Iron Hot-Water Warming Appliances. EXETER, 1880.

" " for Improvements in Thermometrical and Barometrical Instruments. EXETER, 1880.

Ransome, S. E., & Co., 10, *Essex Street*, *W.C.*, for "Milwaukee" Glass Lantern or Hurricane Lantern. CROYDON, 1879.

Rimington Bros. & Co., *Newcastle-upon-Tyne*, for Dean's Gully Trap. NEWCASTLE, 1882.

" " for Enamelled Fire Clay Bath. NEWCASTLE, 1882.

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Ross, W., *Glasgow*, for Improved Paragon Valve. GLASGOW, 1883.
Ruffard & Co., *Fire-Clay Works*, *Stourbridge*, for Porcelain Baths, moulded and glazed in one piece. STAFFORD, 1878.
Salmon, Barnes & Co., *Ulverston*, for Revolving Shutters with Balance Weight Motion. EXETER, 1880.
Scott, A. & R., *Glasgow*, for Midlothian Oat-flour. GLASGOW, 1883.
Scott, F. R. & Co., *Dublin*, for Solid Oak Parquet Flooring. DUBLIN, 1884.
" for exhibit of Furniture. DUBLIN, 1884.
Selig, Sonnenthal & Co. (Limited), *Lambeth Hill*, *Queen Victoria Street*, *E.C.*, for Safety Belt Shippers. CROYDON, 1879.
Shanks & Co., *Glasgow*, for Cast Iron Bath. GLASGOW, 1883. DUBLIN, 1884.
" for Porcelain Lavatories, with moveable caps for access to fittings. GLASGOW, 1883. DUBLIN, 1884.
" for "Eureka" Spray and Plunge Bath. GLASGOW, 1883.
Sharp, C. H. & Co., *High Holborn*, *E.C.*, for Ornamental Inlet Ventilators. EXETER, 1880.
Sharp, Jones & Co., *Bourne Valley Pottery*, *Poole*, *Dorset*, for Rock Concrete Tubes. CROYDON, 1879.
Shone, Isaac, *Wrexham*, for Pneumatic Liquid Ejector. STAFFORD, 1878.
Short, Patrick, *Dublin*, for the Rhinoceros Hide "S" Boot. DUBLIN, 1884.
Silicated Carbon Filter Company, *Battersea*, for Silicated Carbon Double Chambered Table Filters. EXETER, 1880.
" " for Silicated Carbon Filtering Material. NEWCASTLE, 1882.
Sinclair, J., 104, *Leadenhall Street*, *E.C.*, for Chemical Fire Exterminator. CROYDON, 1879.
Skinner, G. H., 13, *North Street*, *Exeter*, for Seltzer, Soda and Potash Waters, and Orange Quinine Tonic. EXETER, 1880.
Smith, Elder & Co., *London*, for Sanitary Publications. NEWCASTLE, 1882. GLASGOW, 1883. DUBLIN, 1884.
Smith, James, *Liverpool*, for Open Grate for consuming Smoke. NEWCASTLE, 1882.
Snell, H. Saxon, *Southampton Buildings*, for Thermhydric Ventilating Hot-Water Open Fire Grate. STAFFORD, 1878.
Stephan, J. A., *Worcester*, for Carbonised Iron Stone Mound Filter for Water. EXETER, 1880.
Stephenson & Travis, *Liverpool*, for Stypium Absorbent Antiseptic Surgical Dressings. DUBLIN, 1884.
Stewart, J., Sen., *Glasgow*, for Disconnecting Chamber for House Drains, with open Stoneware Channels. GLASGOW, 1883.
Stidder & Co., 50, *Southwark Bridge Road*, *S.E.*, for Swivel, Lock Plug, and Overflow for Sink. CROYDON, 1879.
Stiff, James & Sons, *Lambeth*, *London*, for Weaver's Ventilating Sewer Air Trap. STAFFORD, 1878.

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Straker & Love, *Newcastle-upon-Tyne*, for Large Fire-clay Drain-pipes. NEWCASTLE, 1882.
Stretton, S., *Kidderminster*, for Folding Bier and Car for Simplifying Funerals. CROYDON, 1879.
Thomasson & Key, *Worcester*, for Cup Grating for Sinks. NEWCASTLE, 1882.
Thorn & Co., *Stafford*, for Artificial Stone Filters, for Cleansing Rain Water for Domestic Use. STAFFORD, 1878.
Thornburn, William, *Borough Bridge*, for Tubular Calorifer for Greenhouses. NEWCASTLE, 1882.
Townsend & Co., *Newcastle-upon-Tyne*, for China Cups and other Vessels for Invalid use. NEWCASTLE, 1882.
Twyford, T., *Hanley*, for Lavatory Basins. DUBLIN, 1884.
" " for Slop Sinks. DUBLIN, 1884.
" " India-Rubber Connection for Joining Lead and Earthenware Pipes. DUBLIN, 1884.
Tylor, J. & Sons, 2, *Newgate Street, E.C.*, for "Clear Way" Regulator Valve Water Closet, without overflow communicating with Valve Box. EXETER, 1880.
" " for Improved Enamelled Iron Slop Sink, with Regulator Supply Valve. EXETER, 1880.
" " for Improved Full-Way Stop Valve. EXETER, 1880.
" " for "Waste Not" Regulator Valve. EXETER, 1880. NEWCASTLE, 1882.
" " for Hospital Slop Sink, with Waste-not Regulator Valve. NEWCASTLE, 1882.
" " for Bath Locking Valves for preventing waste of water. NEWCASTLE, 1882.
" " for Flushing-rim Lavatory Basin, with Quick Waste. NEWCASTLE, 1882.
" " for Flush-out Urinal Basin. NEWCASTLE, 1882.
" " for Joint for Lead Pipes. NEWCASTLE, 1882.
" " for Water-closets. NEWCASTLE, 1882.
Tyrrell, Brooke, *Dublin*, for exhibit of Furs. DUBLIN, 1884.
Vernon's Patent China and Glass Company, *London*, for Noiseless Ware. GLASGOW, 1883.
Walker, Turnbull & Co., *Falkirk*, for Simplex Cooking Range. GLASGOW, 1883.
Waller, Thomas, 47, *Fish Street Hill, E.C.*, for Cooking Stove with Warm-Air Chamber. CROYDON, 1879.
Walton, F. & Co., *London*, for "Lincrusta Walton." GLASGOW, 1883.
Watson, Henry & Son, *Newcastle-upon-Tyne*, for "National" Water-closet. NEWCASTLE, 1882.
" " for Waste-preventing Flushing Syphon. NEWCASTLE, 1882.
" " for "Crown" Cottage Water-closet. NEWCASTLE, 1882.
Webb, A., *Dublin*, for the "Natural" Boot for Ladies. DUBLIN, 1884.

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Webster & Co., *Nottingham*, for Webster's Photometer. CROYDON, 1879.

Wenham & Co., *Church Street, Croydon*, for Boyle's Mica-Valved Outlet Ventilator. CROYDON, 1879.

Wheeler, J., *Ilfracombe*, for "Pixene." GLASGOW, 1883. DUBLIN, 1884.

White, William, *Abergavenny*, for Hygeian Rock Building Composition. NEWCASTLE, 1882.

Wilby, W., *Dublin*, for Chain Belting for Machinery. DUBLIN, 1884.

Willcock & Co., *Burmantofts, Leeds*, for Fire-Clay Sanitary Sinks. and Water Troughs. CROYDON, 1879,

Willey & Co., *Exeter*, for Gaseliers and Gas Brackets. EXETER, 1880.

Wippell Bros. & Row, 231, *High Street, Exeter*, for Ransome's Artificial Stone Air Brick. EXETER, 1880.

" " for Conservatory Boiler, with Hot-Water Pipe. EXETER, 1880.

" " for Cottage Range. EXETER, 1880.

" " for Chappuis Daylight Reflector. EXETER, 1880.

" " for Fernby's "Paragon" Camp Furniture. EXETER, 1880.

" " for Improved House-maid's Box with Sifter. EXETER, 1880.

Wright & Stevens, for Syphon Flushing Cistern. NEWCASTLE, 1882.

Wright, John & Co., *Birmingham*, for "Cosey" Portable Open Gas Fire, with Platinum Wire and Asbestos Packing. NEWCASTLE, 1882.

" " for Ventilating open Gas Fire. DUBLIN, 1884.

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ADDRESSES AND PAPERS READ BEFORE THE INSTITUTE AT THE CONGRESS & OTHER MEETINGS DURING 1884.

SIR ROBERT RAWLINSON, C.B. President's Address to the Congress. DUBLIN, 1884.

T. W. GRIMSHAW, M.D. Address to Section I. DUBLIN, 1884.
C. P. COTTON, M.INST.C.E. " " II. DUBLIN, 1884.
CHARLES A. CAMERON, F.R.C.S., F.C.S., C.S.S.CAM. " " III. DUBLIN, 1884.

BARTLETT, H. C., P.H.D., F.C.S. Some of the present Aspects of Practical Sanitation. Read at the Anniversary Meeting, July 10, 1884.

BOULNOIS, H. PERCY, M.INST.C.E. Isolation *v.* Ventilation. DUBLIN, 1884.

CAMERON, CHARLES A., F.R.C.S., F.C.S., C.S.S.CAM. The Water Supplies to Irish Towns. DUBLIN, 1884.

CARPENTER, ALFRED, M.D., M.R.C.P., C.S.S.CAM. Education by Proverb in Sanitary Work. DUBLIN, 1884.

CARPENTER, ALFRED, M.D., M.R.C.P., C.S.S.CAM. (*Address*). Annual Meeting, May 7th, 1884.

CLOSE, REV. M. H. The Geological Structure of the Neighbourhood of Dublin. DUBLIN, 1884.

COLLINS, J., F.C.S. Air and Ventilation. DUBLIN, 1884.

COLLINS, J., F.C.S. The Necessity for Efficient Ventilation of Sewers. DUBLIN, 1884.

COMBER, P. F. Some Defects in House Sanitation in and around Dublin. DUBLIN, 1884.

DE RENZY, SURG.-GEN. A. C. C., C.B. The Sanitary Condition under which Cholera Prevails in Northern India. DUBLIN, 1884.

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FAHIE, J. ANGELO. Electric Light from a Sanitary Point of View. DUBLIN, 1884.

FLINN, D. EDGAR, L.R.C.S., M.R.C.P. The Administration of the Public Health Act in Ireland with regard to the Duties of Officers of Health. DUBLIN, 1884.

GRIFFITHS, J. P., M.INST.C.E. Dublin Main Drainage Outfalls. DUBLIN, 1884.

GRIMSHAW, ELIZABETH. The Objects and Work of Ladies' Sanitary Associations. DUBLIN, 1884.

HULL, PROF., M.A., F.R.S. The Supply of Pure Water to Villages in Ireland. DUBLIN, 1884.

JONES, SURG.-MAJOR J. W. The Insanitary State of Small Irish Towns. DUBLIN, 1884.

KENNETT, BARRINGTON, R. V., M.A. The Recent Progress made in some Branches of Ambulance Work. DUBLIN, 1884.

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MACCABE, F. F., M.R.C.S. The Water Supply and Drainage of Small Towns in Ireland. DUBLIN, 1884.

MAGUIRE, W. R., F.R.MET.SOC. Practical Sanitary Lessons derived from 1,000 Sanitary Inspections of Dwelling Houses in Ireland. DUBLIN, 1884.

NICHOLS, G. B. House Drainage. DUBLIN, 1884.

POWER, BYRNE, J., M.B. The Public Health of Kingstown. DUBLIN, 1884.

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PENTLAND, HOWARD, B.A. Temporary Hospitals. DUBLIN, 1884.

ROBINSON, PROF. HENRY, M.INST.CE. Sewage Disposal. DUBLIN, 1884.

STRYPE, W. G. A New Process for Treating and Drying Blood so as to fit it for use as a Manure without creating a Nuisance. DUBLIN, 1884.

SYMONS, G. J., F.R.S. The Fall of Rain in Ireland. DUBLIN, 1884.

SPENCER, E., M.A. The Homes of the Working Classes in Dublin. DUBLIN, 1884.

VACHER, F., F.R.C.S., F.C.S. The Influence of Food on Health. DUBLIN, 1884.

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Australian Health Society, Eighth Annual Report, 1884.	Australian Health Society.
Bad Smell.	Australian Health Society.
Bemrose, H. H., The Sanitary needs of Derby.	H. H. Bemrose.
Blackett, C. R., Disinfectants and Disinfection.	Australian Health Society.
Börner, Paul, Dr., Das Medecinalwesen Deutschlands im Jahre, 1883.	Dr. Paul Börner.
Brett, A. T., M.D., Watford Local Board of Health, Eleventh Annual Report.	Dr. A. T. Brett.
Briggs-Warren, R., Suburban School Houses.	Dr. Irving A. Watson.
Bromby, Rev. Dr., The Emunctories.	Australian Health Society.
Brunetti, Professor, Cremazione E Coservazione dei Cadaveri.	Prof. Brunetti.
Carpenter, Alfred, M.D., M.R.C.P., Diptheria, its Etiology and Treatment.	Dr. A. Carpenter.
Carroll, Alfred Ludlow, M.D., Sewage Disposal and Contamination of Water Supply.	Alfred Ludlow Carroll, M.D.
Children, The Infectious and Contagious Diseases of.	Australian Health Society.
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LIST OF FELLOWS, MEMBERS, ASSOCIATES, AND SUBSCRIBERS ELECTED DURING THE YEAR 1884.

FELLOWS.

1884. Jun. BLYTH, A. Wynter, M.R.C.S., L.S.A., *Court House, Marylebone.*

1884. Apr. CRAWFORD, Director-General Thomas, M.D., 5, *St. John's Park, Blackheath.*

1884. May. FLOWER, Major Lamorock, 12, *Finsbury Circus, and* 48, *Holland Road, W.*

1884. Jun. HART, Ernest, M.R.C.S., 38, *Wimpole Street, W.*

1884. Jul. PRITCHARD, Edward, M.INST.C.E., F.G.S., 27, *Great George Street, and* 37, *Waterloo Street, Birmingham, S.W.*

1884. Jun. SHAW, George, 20, *King Edward Street, Newgate Street, E.C.*

MEMBERS.

* Life Members. † Passed Examination for Local Surveyors.

1884. Feb. BRANTHWAITE, Harrison, F.R.C.S., L.S.A., *Westbury House, Willesden, N.W.*

1884. Apr. CHORLEY, G., *Midhurst, Sussex.*

1884. Aug. *CLARKE, Stephenson, 4, *St. Dunstan's Alley, St. Dunstan's Hill, E.C.*

1884. Aug. *DUDFIELD, T. Orme, L.R.C.P.LOND., 8, *Upper Phillimore Place, Kensington.*

1884. Jan. *EWART, Joseph, M.D., F.R.C.P., *Montpellier Hall, Montpellier Terrace, Brighton.*

1884. Apr. FURLONG, R. O'Brien, M.A., *Clonevin, Killiney, Co., Dublin.*

1884. Jan. *JENKIN, PROF. Fleeming, F.R.S., 3, *Great Stuart Street, Edinburgh.*

1884. May. KINSEY, W. Barns, M.INST.C.E., 5, *Carteret Street, Queen Anne's Gate, S.W.*

1884. Jan. MCARTHUR, SIR W., K.C.M.G., M.P., 79, *Holland Park, W.*

1884. Aug. MAIGNEN, P. A., 32, *St. Margaret Hill, Eastcheap, E.C.*

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1884, Dec. MICHAEL, W. H., Q.C., 45, *Cornwall Gardens, Queen's Gate, S.W.*

1884. Dec. †*PHILLIPSON, Burton R., *Baggot Street, Dublin.*

1884. Nov. POWER, J. Byrne, 1, *Roby Place, Kingstown, Co. Dublin.*

1884. Jul. †*RADFORD, W. H., A.R.I.B.A., *Pelham Chambers, Angel Row, Nottingham.*

1884. Sep. SANKEY, Inspector-General, *Oakfield, Ailesbury Road, Dublin.*

1884. Dec. *SHONKSMITH, John Henry, *Micklegate, York.*

1884. Jan. SWEETING, Richard Deane Roper, M.R.C.S.ENG., L.S.A.LOND., S.SC.CERT.CAMB, *Western District Fever Hospital, Seagrave Road, Fulham.*

1884. Jan. TUFNELL, E. Carleton, 26, *Lowndes Square, S.W.*

1884. Aug. WALFORD, Edward, M.D., L.S.A., S.SC.CAMB., 2, *Paragon, Ramsgate.*

1884. Sep. WEBB, William, M.D., 42, *St. Mary's Gate, Derby, and Worksworth, Derby.*

1884. Jul. †*WILSON, J. B., *Kirklandhow, Arlecdon, Carnforth.*

ASSOCIATES.

* Life Associates. ‡ Passed Examination for Inspectors of Nuisances.

1884. Jan. ‡*ABRAMS, Henry, *Bromley Local Board, and 5, Westmoreland Road, Bromley, Kent.*

1884. Feb. FRANCE, T. W. Chapman, 16, *Bristol Road, Edgbaston.*

1884. Nov. ‡*FAIRCHILD, Samuel C. G., 569, *Wandsworth Road, Clapham, S.W.*

1884. Dec. ‡*KEAL, J., 2, *St. Nicholas Road, Sutton, Surrey.*

1884. Aug. KITE, Charles, 31, *Baronsmere Road, East Finchley.*

1884. Jul. ‡*SHADRAKE, W. A., 8, *Hind Street, Stainsby Road, Poplar, E.*

1884. Dec. ‡*WINSER, F. Sawyer, 24, *Charing Cross, S.W.*

SUBSCRIBERS.

* Life Subscribers.

1884. Aug. DOUGLAS, J., *Burham, Queensland, Australia.*

1884. Jun. *DEBENHAM, F. G., *Cheshunt Park, Herts.*

1884. Feb. *RYMER, Samuel Lee, L.D.S.E., *Croydon, Surrey.*

1884. Apr. SOUTH BLYTH DISTRICT LOCAL BOARD, *South Blyth, Northumberland.*

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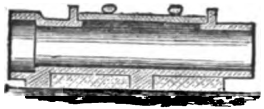
BY ROYAL  LETTERS PATENT.

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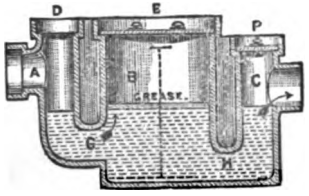

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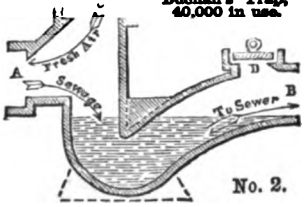

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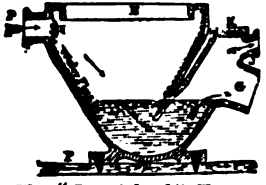

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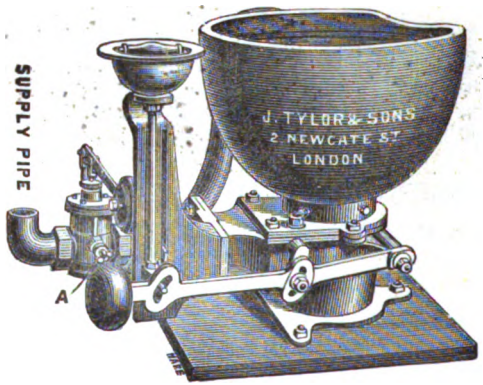

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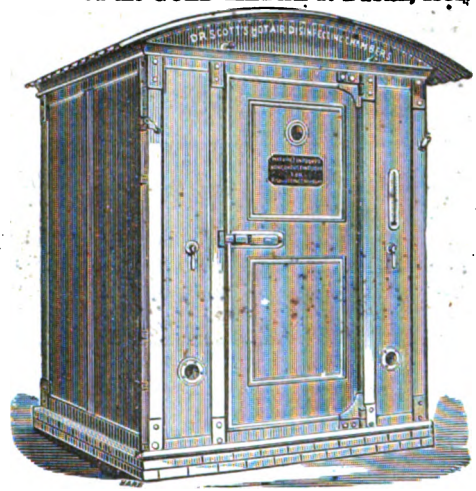

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BLACKROCK, DUBLIN.
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BALLINA, &c., &c., &c.

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Judges—W. H. CORFIELD, M.D. WILLIAM EASSIE, C.E. ROGERS FIELD, C.E. R. THORNE THORNE, M.B. ERNEST TURNER, F.R.I.B.A.

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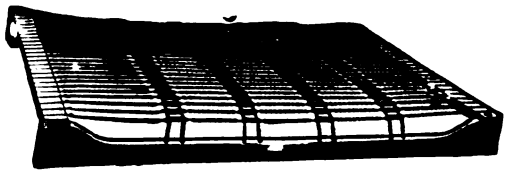

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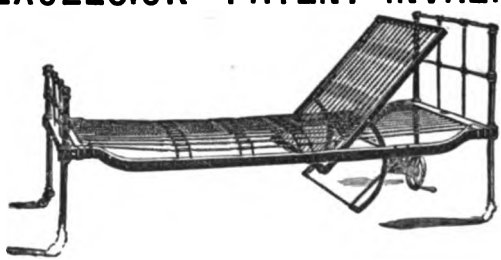
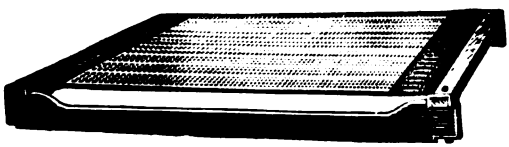
THE 'EXCELSIOR' PATENT INVALID BED.



A patient reclining upon this bedstead is raised or lowered painlessly, easily, and immediately by one person; during the operation the **entire length of the spine** is evenly supported. The patented mechanical arrangement provides for the moveable back and shoulder rest being **accurately adjusted and firmly secured** in any **desired position**; accidents cannot occur from carelessness or lack of physical strength on the part of the attendant, as whenever the handle is released, by intent or otherwise, the mechanism is instantly interlocked, and the back and shoulder rest firmly fixed, it being again moveable only by motion communicated through the handle.

THE 'SWING' WOVEN WIRE MATTRESS.

PRIZE MEDAL AWARDED AT THE



SANITARY EXHIBITION, DUBLIN, OCT., 1884.

This Mattress is an entire novelty in its conception and arrangement, and unquestionably embraces advantages possessed by no other elastic web or woven wire mattress. Its leading peculiarity is the unique combination of a woven wire central portion with helical springs of great strength and reliable temper. The addition of suitable helical springs to a woven wire mattress *removes* the great objections made to this kind of mattress, viz., that two sleepers are liable to be thrown or moved into the centre of the bed, and that the mattress depresses or becomes hollow from constant use.

RETAIL FROM CABINET MAKERS, UPHOLSTERERS, & FURNISHING IRONMONGERS.

Illustrated Descriptive Circulars and Price Lists from

CHORLTON & DUGDALE, MANCHESTER.

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